THE

ELECTRICAL REVIEW.

VOL. XXXV. OCTOBER 26, 1894. No. 883

CONTENTS:

	PAGE
The City Electric Lighting	489
The Battle of the Curves	490
Earth Currents	492
The Liverpool Overhead Railway	493
The Lead Dust Accumulator.—Cooking Coils *v.* Resistances ...	494
American Street Railway Investments	495
The Diseases of Dynamos.—II.	496
Poole's Patent Electrician's Wire Gauge (*illustrated*)	497
Regulation of Phases in Working with Alternating Currents (*illustrated*)	497
The Turnbull Incandescent Lamp (*illustrated*)	498
The Krueger Theatre Arc Lamp (*illustrated*)	499
Reviews:—Outlines of Electrotechnics	499
The Practical Engineer's Pocket Diary, 1895	500
Central Station Book-keeping	500
Correspondence:—Electric Lighting at Folkestone	500
Localising High Resistance Faults in Submarine Cables ...	501
Harmonic Call Bells—The Submarine Detector	501
Notes on the Steam Turbine.—The Starting of Motors ...	502
Efficiency of Modern Glow Lamps	502
Turning Down the Electric Light	502
The Magnetic Qualities of Asbestos	502
Vacuum Tubes.—Braulik *v.* Sharp & Kent	502
The Chloride Electrical Storage Battery	503
Report of the Post and Telegraph Department of Queensland ...	503
Business Notices, &c.	504
Contracts Open and Closed.—Books Received	507
Notes	507
City Notes	510
Traffic Receipts	510
Share List of Electrical Companies	511
The American Electro-Therapeutic Association:—	
Address by the President	512
Report on Secondary Batteries	512
Electro-Physiology	513
Photographic Electric Lights	515
New Patents	515
Abstracts of Published Specifications	515

THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

PRICE 4/- POST FREE.
The Leading Electrical Trades Directory *and the Oldest Electrical Directory in the World.*

1895 ISSUE NOW IN PREPARATION.

PRICE 4/- POST FREE.
Fully Revised and Thoroughly Reliable.
Contains a larger amount of Trade Matter than any other Electrical Directory.

H. ALABASTER, GATEHOUSE & CO.,
22, Paternoster Row, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established **1872.**

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—22, PATERNOSTER ROW, LONDON.

Telegraphic Address: "ASHREAY, LONDON." Code A B C. Telephone No. 517

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In *Great Britain*, Post Free, per Year, 19s. 6d. To all *Foreign Countries* (except those mentioned below), per Year, £1 1s. 8d. *Exceptions.*—Abyssinia, Aden, Borneo, Ceylon, India, Java, Labuan, Mozambique, Penang, Persia (*viâ* Brindisi), Phillipine Islands, Singapore, Zanzibar, to which the rates are: per Year, £1 8s. 10d.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. *Paris:* VEUVE J. BOYVEAU, 22, Rue de la Banque. *Berlin:* ASHER & Co., 5, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payabl to MR. H. ALABASTER 22, Paternoster Row, E.C.

THE CITY ELECTRIC LIGHTING.

IT seems to us that the path of the company which is supplying the City of London with the electric light can scarcely be said at the present juncture to be one strewn with roses. Hitherto the obstacles to its progress have been comparatively light to those which, we fear, are looming in the distance. Taking competition first, it can scarcely be denied that the new incandescent gas burner will prove to be a thorn in the City Company's side, for notwithstanding the criticism to which it has been subjected, especially in our own pages, it is too much to expect that all large consumers of light will either be made aware of what we have said concerning the Auer-Welsbach invention, or that even supposing they had, they would not exercise their own judgment in deciding upon the kind of lighting to adopt. In any case, it is suicidal policy to shut ones eyes to the fact that what a contemporary, following in our wake, calls a bilious looking contrivance, may, if energetically pushed, form as serious a rival to incandescent lighting by electricity as it has already in Germany.

A second very serious matter for the company to consider is the means for providing against those disagreeable and too frequent mishaps to the generating machinery, or its paraphernalia, which give rise to the total extinctions of the light to the intense annoyance and discomfort of those who have adopted it. This subject is really one calling for prompt attention, for while we published an authorised version of the last mishap sent to us by the company's secretary, which was absolutely at variance with that given by the *Electrician*, another contemporary states that neither account is altogether in accord with fact. If breakdowns can occur for which, at least, three reasons may be assigned, it will, we think, be assumed, and not without reason, that to rely upon the infallibility of the City Company's supply is very much like leaning upon a broken reed. One thing we would decidedly advise, for many reasons; our advice may be taken for what it is worth, but it is, that parallel running of the Mordey alternators should be abandoned.

It has been found at other smaller stations which run Mordey alternators that the liability to breakdown of the armatures is enormously increased by running the machines in parallel. This had become so serious at one of the stations recently erected that it was decided to run the machines separately instead of in parallel, and only putting them into parallel for the purpose of changing over the load and manipulating without producing an intermission in the light. The results obtained in this way are said to be most satisfactory in comparison to the state of affairs existing beforehand.

A similar experience has also been gained in other places, and we may confidently say that the stations which use Mordey alternators, and which give the best results, are those which do not run in parallel. We should, therefore, seriously

urge upon the consideration of the City of London Company the re-arrangement of their system of mains and sub-stations, so as permit of the machines being run upon separate circuits, when we might hope that the security thus obtained would be much greater than at present.

There is, in the City article of *To-Day* for October 20th, the following:—"To be plunged into darkness during business hours is a serious matter, and it might be well if some disinterested person would enquire from the City of London Electric Lighting Company why their cables have so rapidly worn out. It is stated openly, in certain well-informed quarters, that when the City of London Company called in tenders for their cable supply, the tender made by one of the oldest and best of the cable companies was passed over in favour of that of a much smaller company, asking a considerably higher figure. Such is the advantage of a friend at court. Still more strange is it that now these cables have so signally failed, the older company has been called in to repair and make good their former rival's faulty work. Shareholders in the City of London Electric Lighting Company would do well to have this matter cleared up."

We do not pretend to have any knowledge of this new phase in the company's operations, nor of the reference to a friend at court. As it stands, one can only assume that it is intended to convey the impression that somebody in the City Company has a direct interest in certain cables, an insinuation which we cannot credit, and which will doubtless be at once contradicted, for the company will scarcely allow such damaging statements to be made without instant retort.

In the interest of good work we should like also to be informed if the triple concentric lead-covered cables, which have been so largely used this year in the city, are alluded to, because the recent mishap was not due to any failure of the mains. We have it on good authority that the City of London Company has laid down a most extensive system of mains of the very highest quality, and their complete freedom from breakdown is held to be most encouraging.

Now, coming to the City itself, and the business carried on within its limits, we cannot but feel that here above all places in the kingdom we might go so far as to say of all places in the world, it seems desirable, aye, absolutely necessary, to be in readiness to supply current at any critical moment for the whole of the lamps wired. Is the City Company prepared to do this, or only for an estimated 80 per cent. of the whole? Judging from the under-incandesced state of the glow lamp filaments when there is any special demand for extra lamps, we should say distinctly that their estimate of the proportion of the number in use at one time to the number joined up is clearly inadequate. This, however, may not be entirely in the power of the company to deal with satisfactorily at present, for electric wiring firms were over-zealous in inducing customers to have their premises fitted up long before the company was in a position to supply anything like the number of applicants for electrical energy. At the same time, was not the company to blame for encouraging customers to use lamps of an unnecessarily high candle-power, in order to have a high load, before they were prepared for it?

We are not losing sight of the method generally adopted for fitting up central stations with plant capable of giving an output for supplying a certain percentage of the total number of lamps wired, because it has been estimated that at any given time only that percentage of lights are used at any one period; but for the City of London we think this rule should be very considerably enlarged, if indeed the plant should not be capable of easily coping with the entire number of lamps. Our own impression is that the City Company, having discarded the assistance of all practical experience in this matter, which would have advised them to decline custom which they could not fully supply, has to some extent been directed from the point of view of Stock Exchange interests, and is now suffering the inevitable penalty of ignoring procedure on sound engineering principles.

London city, as a lighting centre, is unique. It is utterly different from any other place, and should be so looked at by the suppliers of light, who cannot use all the data obtained from other sources for guidance here, although some parts of the city resemble, in this respect, other parts of London. It is a winter's day-load, subject to fogs, and as such can have little character about it; therefore it is, as we have said, really necessary to be prepared for a much larger proportion of the maximum number of lights than elsewhere. What that proportion is is probably at present unknown, and will remain so until larger areas and greater varieties of demand are being supplied. Meanwhile, during the growth of the system, ordinary foresight should have kept the growth of the means of generation in advance of the total possible consumption.

We have been at the pains to bring these points forward because of the muttered grumblings respecting the City electric lighting which have reached our ears, but we would ask the discontented ones to remember that they are dealing with a young industry, not yet perfect, but which has to feel its way through the rocks and shoals besetting everything new, and through which they should try to steer it clear. At the same time there can be no harm done in trying to make clear to the City of London Company certain points which may not have been forcibly brought to the notice of those responsible for its working.

THE BATTLE OF THE CURVES.

We see by our American contemporaries that the battle between sine curves, peaky curves, and top-hat curves, still animates the zeal of their various supporters on both sides of the Atlantic, and the victory of the sine curve over its opponents is still uncertain. The question is, in some cases, still more obscured by unfortunate confusions between the induction curve and its resulting electromotive force one. The question would seem, from the nature of the phenomena involved, not to be susceptible of an answer in favour of one form over the others for all possible uses to which alternating currents can be put, inasmuch as the requirements of arc lamps, incandescent lamps, and the various types of motors used with such currents are to some extent antagonistic. The chief point on which those who are opposed to the sine curve dwell is, that any curves with the same maxima must necessarily have the same losses due to hysteresis; as far as is known, this is quite true; but it is not so

clear that the *total* core loss, and any other smaller losses due to Foucault currents, may not be increased by any considerable departure from a sine curve. Of course, such extra losses over and above hysteretic ones would, in most practical cases, be very small, and, so far, the opponents of the sine curve have the best of it. There can, however, be little doubt that the presence of upper harmonics of *large* amplitude would be detrimental both to power transmissions and the working of alternate current motors for reasons which are well known to all who have followed the controversy as far as it has gone, especially in respect to increasing the drop on inductive circuits and the wattless current in mains of large capacity. It may be questioned whether it is worth while spending much time and money in designing machines to give absolutely perfect sinusoidal curves, inasmuch as everyone knows that the nature of the load on any dynamo or transformer, whether it be full load or low load, or inductive load or non-inductive, has more influence on the form of the volt and current curves than the fact of its primary induction curve being a true sine curve or not. Probably no alternator in the market, which is intended for supplying lamps by transformers, has a curve of induction differing much more than 10 per cent. from the sine curve, and it is to our mind very doubtful whether it is worth while trying to improve on this, although there seems no adequate reason why one should go out of one's way to make it more divergent from the sine curve than present practice does.

Single-Post Elevated Railways.

The latest comer in railways was lately described in the *Electrical World* as the invention of J. P. Hanlon, of Boston, and consists of a single rail carried on a single line of posts, similar, in fact, to the single posts which carry the present elevated lines along the Bowery of New York. The car which runs on this single central rail is approximately circular in cross section, and is further supported and kept in position by another single rail overhead, this overhead rail being supported by a series of hoops which spring from the top of the supporting posts and encircle the cars, a gap being left for passage of the bar carrying the car from the upper rail. There are guard wheels to take the lateral pressure at curves. The illustration is purely ideal, we should imagine, and no details have been thought out, for we observe that the various wheels have a maximum diameter of about a foot, and a minimum of about four inches. No motor is illustrated or described and nothing is said about the attainment of other than ordinary speeds, so that there is nothing in the idea that is impracticable, though, of course, the details, notably the wheels and the hoop iron upper rail supports will require to be immensely heavier and stronger than shown. The idea is after all only another resurrection of Danchell's scheme, like the Boynton idea we criticised in our last issue, the single posts alone being perhaps additional, but certainly not novel. As we pointed out in referring to the Boynton railway, we should rather fear considerable noise from the guard wheels above. No line on the system has yet been built, but it is the intention of the promoters to apply to the Massachusetts legislature to construct, equip, and operate the system through Boston and adjacent towns. No trouble is expected from the necessity of making the upper rail movable in places for allowing a second line to cross at right angles, or for switching purposes, a little operation, by the way, which will involve considerably more work and expense in structural details than the few words in which the operation is referred to would seem to convey. This difficulty at crossings which seems to be inseparable from the single central rail principle must always act prejudicially against it. The question of points is a little awkward, but the actual rail gap necessary at a crossing is a bad feature that may cause accident, and must involve some means of bridging the gap by means of the various wheels, vertical and horizontal, to ensure continuous contact and support. The idea may look well enough on paper with a few simple illustrations of no real significance, but for cars of 50 feet length, other considerations come in and must be attended to. These new ideas and resurrections are all half fledged; no one of them is presented in a carefully considered form that can stand any real criticism as a going concern.

The Behaviour of the Electric Current in Bad Conducting Fluids.

Some interesting phenomena resulting from the passage of electricity through bad conducting fluids are described by O. Lehmann in *Wiedemann's Annalen*, Vol. lii., p. 455. It is well known that in the electrolysis of good conducting fluids changes appear to take place only in the neighbourhood of the electrodes. Lehmann has found with bad conducting fluids that certain changes start from each electrode and meet in the middle where a precipitate is produced. Solutions of the aniline colours showed the phenomena very distinctly. When a current of 70 volts tension was sent through an aqueous solution of Congo red, sharply defined halos were formed about both electrodes; that proceeding from the anode was of a beautiful blue colour, but that from the cathode was somewhat paler than the solution, though it was distinctly defined by a darker outline. Both halos extended themselves quickly and met finally in the middle, when a dark blue precipitate was suddenly formed next to the anode, while the colour was completely discharged from a corresponding space next the cathode. Where the dark blue and colourless layers met, the fluid was thrown into violent agitation, while the rest of it remained undisturbed. The rate of advance of the halos through the solution was found to increase with the tension of the battery employed. Observations were facilitated by thickening the solution with gelatine, sugar, or glycerine. It could then be easily ascertained that the spread of the halos was not due to currents in the fluid, as particles of dust and air bubbles remained quite stationary. At the same time, the rate of spreading was found to be retarded by increasing the viscosity of the fluid, and it was found necessary with very viscous fluids to use higher tensions. The outline of the halos then took a jagged form, which became finer the higher the tension used. The observations just described were made with the microscope, but the phenomena may be seen with the naked eye by inserting the electrodes in a block of very loose jelly at a distance of 90 mm., and turning on the current for about 10 minutes, when the halos will meet in the middle and produce the precipitate as in the solution above mentioned. When the precipitate is formed a violent agitation is observed at the place of meeting inside the mass of the jelly, the precipitate is soon re-dissolved and the gelatine melted by the great heat evolved. Lehmann's explanation of these curious phenomena is, that the positive and negative electrification of the electrodes is handed on from molecule to molecule, till, finally, positively and negatively electrified molecules stand opposite each other in the middle of the fluid or jelly, when they are violently attracted to each other and produce new chemical compounds and heat. These experiments ought to throw a good deal of light on the still unexplained phenomena of the electric discharge through non-conducting gases and liquids, and also on the phenomena of electrolysis and chemical action. It would appear to lend considerable support to the view that atomic charges play an important part in both the latter.

EARTH CURRENTS.

By E. O. WALKER, C.I.E., M.I.E.E.

Prof. Palmieri has recently contributed to *L'Eclairage Electrique*, the results of observations at the Vesuvius Observatory, of earth currents since the end of the year 1889. The lines employed were from the Observatory to Resina on the seaboard, a length of eight kilometres to the south-west, and a shorter one whose permanent direction was north-west, and which was earthed in a ravine on the side of the mountain named the "Fosso della Vetrana." This last line was capable of being shifted to different directions in the course of observation. The Professor found that the galvanometer first used, which consisted of the usual arrangement of a needle within coils, became untrustworthy after storms, owing to its magnetism being much changed. He looked about for some other apparatus in which such modification would not occur, and the aperiodic electrometer of D'Arsonval suggested itself; but here inconvenience was experienced by the fusion from strong discharges of the fine metallic thread which sustains the movable coil. An instrument was therefore constructed as follows:—A cylinder of soft iron, 86 millimetres in length, and 11 inches in diameter, was wrapped with 4,200 turns of fine copper wire; over this was suspended by a silk fibre a magnetic needle moving over a scale, and permitted to find a position of rest in the magnetic meridian at right angles to the axis of the bobbin. Palmieri calls the apparatus a "rheometer," and tests its sensibility with a small copper-zinc-water element, the current from which produces a deflection of the needle of about 70 degrees. The apparatus is almost aperiodic. Finding that the iron core was subject to hysteresis after the passage in the bobbins of strong currents, which confused the subsequent readings of the needle, he altered the shape of the coil by slightly flattening it, and used a flat iron strip for the core which could be easily slipped in and out, and replaced by another if polarised. Palmieri kept alongside of this instrument a Nobili and a D'Arsonval galvanometer, in order to admit of the use of the former for very weak, and of the latter for very strong currents, which his own device was incapable of registering.

The Observatory is 1,200 metres above the sea, on the edge of the cone of cinders anciently thrown out by Vesuvius.

It is found that, as a rule, the earth currents come up the mountain from Resina and from Vitrana, and that on the occurrence of rain or of storms, even at a distance, they showed extraordinary increase in strength. The variations were usually small during one and the same day, but often very marked from day to day. When the circuit was extended from Resina to Portica, a neighbouring town, the phenomenon was similar. It is incidentally noticed that an alteration in position of the earth plate does not materially affect the sign and strength of the current, and the same fact was noticed in India some 10 years ago. It is an important one in strengthening the belief that the *fons et origio* of these currents is on or above the surface of the earth. From the year 1889 to the end of August, 1893, the currents had been constantly flowing up the lines; there was then a rapid decrease, and a subsequent change in direction. This change was coincident with an increase in the activity of Vesuvius, notably in the open chasms of the "Atrio del Cavallo." The currents now continued to flow downwards until the volcano quieted down early in the month of February, 1894, when they again changed direction, showing feeble intensity at first, but soon increasing in strength. The central crater began then to vomit, and the earth currents again displayed the same peculiarities as before and varied in direction according to the activity or otherwise of the eruption. Up to the end of April, 1894, the limit of the observations here described, the currents had remained descending. Palmieri notes that Vesuvius is never in absolute repose and the seismic apparatus always registering vibrations, but that the earth currents are always preceded in change of direction by *strong* movements. He sees no way at present of accounting for this inversion, and while admitting that atmospheric electricity acts as a perturbing force, he does not appear to attribute the existence of earth currents to differences of its potential or sign at summit and base of the mountain. Nevertheless, Palmieri has found that the electric state of the earth is always opposed to that of the air above it, because, he thinks, the former is induced by the latter; he has, in addition, found at places distant from each other only a few kilometres, not only electrification of different intensity, but also of different sign. He quotes Naples and the observatory of Vesuvius as a case in point, and a more curious instance at Capodimonte and Portici, within a kilometre of each other, where, during rain, positive electricity was found at the latter place and the opposite at the former. But the currents which have been of late flowing down the lines seem to have been less influenced by atmospheric electricity, in spite of the frequent storms which marked the autumn of 1893.

Palmieri incidentally mentions the interesting coincidence of earth current variations, of the eruption of Vesuvius, and of the eclipse of the sun of June 17th, 1890.

Measurements of the electromotive forces of the currents are not given in this paper, which is to be regretted; without them it cannot be appreciated to what extent the electrochemical effect of the soils upon the earth plates influences the current up or down the mountain.

Palmieri is of opinion that earth currents should be examined by different methods from those adopted in early researches; that the direction of a current should be studied for different inclinations of the line to the horizon, and in different azimuths; and if lines for study are established, according to classic procedure, equatorially and meridianally, such lines ought to be at the same level. Finally, observations should be made at the same time of the conditions of atmospheric electricity at several points in the region under examination.

Another similar case to that of Vesuvius is quoted, where a descending current prevailed, namely, at Pike's Peak, in Colorado, 4,730 metres above sea level, where, from this cause, communication by wire with Colorado Springs, at the foot of the mountain, was rendered difficult.

Mr. H. N. Dickson's observations at Ben Nevis in 1886, by means of cable to Auchintee Farm at the base, and on by ordinary telegraph wire to Fort William, showed that the direction of the earth currents was influenced by humidity. There was a strong current down the cable during the time that vapour was condensing on the summit, and the reverse when the air became dry. There were, besides, daily variations, including two periods of descending and two of ascending current. The observations related to a part of the year when fog and storms prevailed. Mr. Dickson attributed the currents to differences in potential of the air at summit and base. He quoted the tests of Professor C. Ritchie Smith on Dodabetta, a mountain 8,000 feet high in the Nilgiri Range, in South India, which showed that on the edge of a *dissolving* mist the potential is lower than the normal, while it is higher on the edge of a *condensing* mist.

So far as is known in India, the prevalent earth currents are between places having different conditions of the atmosphere. They are very marked when one station of observation is on the sea coast and the other inland, especially when the line joining them lies east and west. Mr. G. K. Winter noticed this fact at Arkonum, on the Madras Railway, in 1873. Should one station be considerably higher than the other, the effect is intensified. But between two places, both inland or with little relative climatic difference, the earth current is insignificant. It would not appear that there are, consequently, great streams of current in the earth's crust, although it would appear that "magnetic storms" induce simultaneous effects throughout the globe. It is interesting to recall that Mr. C. F. Varley, in 1867, observed a negative cloud during a snowstorm on the Rigi possessing a potential of 400 volts; the atmosphere remained negatively charged for an hour and a-half.

The connection between earthquakes and earth currents has often been noticed. Mr. Varley, at the Society of Telegraph Engineers in 1873, mentioned an instance where 120 miles of cable in a tank had, at the time of an earthquake, received an induced current. Professor W. E. Ayrton, at the same meeting, said that in February, 1871, strong currents from Calcutta up the lines to the north west had prevailed a day or two before an earthquake. Volcanic eruptions in Java and in Sicily, in 1884, affected earth currents in India.

All these manifestations are witnessed if the terminals of the lines merely rest on the surface of the earth, showing

that the internal strata do not immediately affect the phenomena. Evidently there is scope for many more observations in different parts of the world to enable somewhat apparently conflicting facts to be reconciled.

THE LIVERPOOL OVERHEAD RAILWAY.

The papers by Messrs. Greathead, Fox, and Parker, on this railway and its equipment, together with the discussion thereupon and the drawings, as presented before the Institution of Civil Engineers on February 27th last, have recently been published. Those who heard the papers read and were present at the discussion, will hardly recognise in the flowing periods in the third person and past tense of the speeches as printed, the halting, maimed, and ejaculatory style which disfiures so many of the discussions upon engineering papers; and while speaking upon the literary side of engineering training, Prof. Kennedy might not inaptly have referred to this failing in the matter of spoken discussion, wherein all our English societies compare so unfavourably with American.

When the Institution is engaged in listening to a paper on earthworks or bridges, its proceedings are—if dull—not particularly venomous, but let an evening be given over to a paper involving anything specially mechanical, and particularly when steam engines and boilers are concerned with rates of water and fuel consumption or efficiencies, and all harmony disappears:

> Wi' warldly trust,
> Vile self gets in;

and the manufacturing gentlemen present are quite unable to be pleasant. True they say pleasant things to each other and altogether disclaim having the slightest doubt of the accuracy of the statements made, but they damn with faint praise all along the line, or crow lustily over victories claimed for their own bantlings in a self-advertising manner that ought to be kept out of what are only intended to be purely professional discussions.

We have already described the railroad itself pretty fully. The present paper is rather one dealing with construction and working. Considering the novelty of the undertaking in this country—this being the first elevated line on the American system that has been constructed here; seeing that it is an advance in character and solidity upon the American lines, that the motive power is electricity, and that the lines are full gauge, and the working exceedingly satisfactory in both a mechanical and a financial sense, even the automatic electrical system of signals sharing in the general success and contributing to it, we think much of the criticism is not in the best of taste. Liverpool, in respect to its business passenger traffic, is very much on a par with New York as regards a mixed residential and business traffic. Both are long and narrow cities, Liverpool extending some seven or eight miles along a river front, and New York eventually will extend some ten miles along two river fronts. New York has its four elevated steam-worked lines; these were too lightly constructed and are therefore noisy. They have open floors, because solid floors would shade the street beneath. This does not count at Liverpool, because there is not a public street beneath the line. But New Yorkers could not now forego the L lines which last year carried 221 million passengers. This, of course, is far ahead of anything likely to be reached for some time at Liverpool, the maximum traffic of which appears to have amounted to 40,000 passengers in eight hours, which is about three times the average annual rate per mile of the New York lines, reckoned at 18 hours daily for 300 days annually, or about $1\frac{3}{4}$ times the mileage rate of the more crowded Third Avenue line. We have not figures before us to show what is the rate on the Third Avenue line during eight hours, but our recollection is that, at busy times, the "down town" traffic is denser than that of the Liverpool line on Easter Monday last, when we were over it.

A notable feature in this line is the Hobson flooring of arched plates pressed from $\frac{5}{16}$-inch steel, the trough running longitudinally to the road, and carrying the transverse sleepers direct. The trough edges are riveted together, a ⊥ iron web coming between them, and the V between is filled with asphalte. Mr. Shoolbred criticised the thickness of $\frac{5}{16}$-inch unfavourably, as liable to be weakened by corrosion. Now $\frac{1}{4}$ inch is usually held to be a minimum thickness in bridge work, and the tests clearly show $\frac{5}{16}$ths inch to be ample for strength and stiffness, while the rest is simply a matter for maintenance—a question of paint and tar. Without paint even a half-inch plate, as pointed out by Mr. Greathead, would be insufficient, and would drop away in large flakes of rust, just as the roof of Cannon Street Station is now doing, so that money may be found for ill-considered and spiteful litigation. The power house seems well selected, about midway of the line, under the arches of the Lancashire and Yorkshire Coal Railway. Thus the coal is tipped direct into hoppers over the boilers, whence it is conveyed to the shoots of the Vicars mechanical stokers.

This entirely abolishes handling of the coal. There are six 8 feet by 30 feet Lancashire boilers at 120 lbs. pressure to drive 1,600 H.P. condensing Corliss engines. This strikes us as an excessive boiler power for even slack coal with compound Corliss engines, but we are not informed how many are under steam at once. The coal consumption per I.H.P. hour is given as 2·96 lbs., but the water consumption is omitted. Assuming this to be 15 lbs. gives a very low evaporative duty for the coal, but we observe that Mr. Crompton congratulates the author on the evaporation, which, however, we fail to find stated. Mr. Crompton also finds fault with Mr. Parker's claim that the efficiency of conversion as between the I.H.P. and the dynamo terminals is 88 per cent. Impossible, says Mr. Crompton, with rope-driven plant, because he himself had been unable to get so much. True, 88 per cent. is a trifle high, but the side stress on the bearings may have been less mischievous than at Chelmsford. This, of course, is largely a matter of sufficient length of bearing. Now, if Mr. Parker did really secure an electrical efficiency of 97·7 per cent., the resultant 88 per cent. leaves, after all, only 90 per cent. efficiency for the engine mechanism and the ropes. Mr. Crompton, however, seems hurt to think that Musgrave's engines could approach Sulzer engines in efficiency, and these latter only secure at best 91 per cent. for engines alone. Mr. Parker, in his reply to Mr. Preece, who also looked upon rope driving as old fashioned, stated simply that there was *no proof that high speed direct driving engines did not absorb as much power* as ordinary engines with *ropes*. The reply fits Mr. Mark Robinson's criticism, this latter gentleman, by correspondence, flatly denying that 88 per cent. had been attained. Mr. Robinson finds that 87 per cent. is the maximum possible, not deducting the rope friction, and would therefore add more ropes, for they must have been making power. He denied that even 80 per cent. had been secured but unfortunately could not resist crowing over what he styled the "victory of direct coupled plant now beyond recall." Mr. Robinson should be aware, however, that in Lancashire there is not that profound belief in high speed engines that is to be found in some other quarters, and whether the 88 per cent. be accurate or otherwise, there is perhaps not any great unwisdom in applying cotton driving ropes at Liverpool and to Bolton made engines, such as, so far, have given the best results in Bolton mills. After all, 3·34d. per train mile for all power, maintenance, drivers, superintendence, stores and cleaning, is not a bad showing.

The rope speed appears to be about 4,400 feet per minute. This, with 19 ropes of $1\frac{1}{4}$ inches diameter each, should deal with an indicated horse-power of 525. It would therefore be sufficient to use 15 ropes on each drum. As it is so easy to fall into slight errors in short tests which considerably alter percentages, it might have been well if Mr. Parker had claimed a less efficiency than 88 per cent. Such high results only give handles to be seized upon by criticism. Mr. Siemens also disbelieved in the high efficiency, not only for rope driven plant, but also for direct coupling. We are ourselves a little inclined to agree with Mr. Robinson in his criticism of the 2·96 lbs. of coal per I.H.P. hour. As he says, with only 7 lbs. evaporation, this gives 21 lbs. per hour for water, which is certainly too high. The time, $3\frac{1}{2}$ hours, is far too short to determine the coal consumption, 4,032 lbs. We doubt the coal weight more than anything else. Reduce this to 3,000 lbs., and the evaporation and coal per H.P. hour both become more reasonable, namely, 7 lbs. and $2\frac{1}{4}$ lbs at 16 lbs. of water per H.P. Dr. E. Hopkinson obtained the result from Mr. Parker's figures that the tractive resistance was 55 lbs. per ton of train as against 13 lbs. on the City and South London. Deducting the accelerating force

left 35 lbs. per ton resistance at 21 miles, and he believed that there had been some confusion as between the tractive force of one and of two motors.

Mr. Parker did not reply to this further than to point out that the Liverpool motors had better tractive force in accelerating trains, and we think that passengers on the two lines would certainly award the palm in this respect to Liverpool, for as Mr. Parker pointed out, the trains were 12 per cent. heavier, ran 24 per cent. faster, and stopped 50 per cent. oftener than on the London line, and undoubtedly the speed attained at Liverpool is most excellent on such short runs. Mr. Siemens's figures *re* train mile energy consumption are thus useless without such inclusive facts. If there is one thing about the Liverpool line more educational than another, it is that the running of the circle trains on the Metropolitan might be at least attempted by electricity. True the carriages might be lighter (and might carry less dirt) and trains shorter and more frequent to fit them for the service. So far as regards the actual tractive force employed, we believe little is known of either of the electric lines, nor what is the actual proportion of energy consumed in running and run to waste in starting. Coming back for a moment to the engines, we find these have a coefficient of 13·6 per pound of effective pressure, and should therefore indicate with 115 lbs. initial pressure about 544 horse-power with about 10 expansions. 400 I.H.P. corresponds with about 14 expansions. So far, then, as Mr. Parker's figures take us, his horse-power seems, on the face of it, reasonable; the diagrams he gives have a thoroughly honest appearance, and such as one sees regularly from Corliss engines, but we cannot understand the 2·96 lbs. of coal per I.H.P. hour, unless the engines were out of order, nor does the evaporation fit in. The piston speed at normal speed is 600 feet per minute, and the steam consumption ought not to have exceeded, say, 15 or 16 lbs. It is a pity the water was not measured. Now at 16·1 miles per hour the E.H.P. absorbed was 46 by a train of 39 tons. That is at 1,416·8 feet per minute; the expenditure at the dynamo terminals was 1,518,000, foot-pounds per minute, or a traction of 1,071 lbs. to haul 39 tons. This shows some 27½ lbs. per ton, or much less than what Dr. Hopkinson deduces by another method, which would seem to sustain him in his opinion that Mr. Parker had confused the tractive power of two motors and one motor. We think, however, that if the speed of the test train was fairly well determined as 16·1 miles, and the E.H.P. as 46, the simple method above must be fully as accurate as Dr. Hopkinson's deduction of 35 lbs. Still, 27½ lbs. seems high for simple running. What, however, does Dr. Hopkinson mean by average tractive force on the South London line of 13 lbs. per ton, and comparing this with running tractive resistance on the Liverpool line? Does Dr. Hopkinson mean it to be understood that 13 lbs. covered the accelerating force as well as the resistance of uniform motion?

(*To be continued.*)

THE LEAD-DUST ACCUMULATOR.

By the courtesy of the Gelnhausen Electrical Company, we are enabled to give a description of this apparatus.

The active mass of the electrodes consists of a mixture of lead-dust—produced from crude lead by mechanical means—and neutral substances of a porous structure. The supporters are slips of compressed lead. The Gelnhausen Company has also obtained a general license for Faure's German patent.

The lead-dust accumulator may rank as an improvement for the following reasons:—

During the discharge, the lead peroxide in the positive electrode is converted into lead sulphate. This change is effected first on the outer surface of the active mass and gradually penetrates deeper as the discharge continues. If the filling-mass consists entirely of oxides of lead, there are formed, by the conversion into sulphate, closed strata, beginning at the surface. The resistance determined by these closed strata occasions a fall in the tension of the accumulator so as to reach the lowest admissible tension, so that the discharge must be suspended before the lower strata have begun to yield current.

The active mass then consists in the external layers of hard lead sulphate, but in the internal layers of spongy lead peroxide. The behaviour of the two heterogeneous substances with respect to resistance and expansion, must act injuriously upon the adherence of the active mass, causing it to crumble away and even to fall out.

In the positive electrode of our accumulator, the considerable quantity of the neutral and porous substance intermixed with the lead prevents the particles of lead peroxide (converted into lead sulphate) from forming closed strata.

The deeper strata are not excluded from the emission of current, but participate in it in their totality. Hence the mass is uniform in structure, and is not exposed to crumble away or fall out of its position.

Professor Dr. Krebs (of Frankfort-on-the-Main) has explained that "the high porosity of the electrodes in our lead-dust accumulator allows the gases generated—oxygen and hydrogen—a much more complete entrance into the interior of the active mass than can occur in the far denser structure of electrodes, which are exclusively covered with lead oxides.

The gases can be condensed in the extremely porous lead-dust electrodes; now, the chemical action of condensed gases is far more powerful and rapid.

We may conclude that in the porous lead-dust electrodes, the oxidation and reduction of the active mass will be effected more completely and rapidly by the better penetration and the more rapid action of the gases than in the much denser active mass of electrodes, which consist exclusively of lead compounds. In the former all the active mass is brought into chemical activity, whilst in the latter the surface alone is active.

CHOKING COILS v. RESISTANCES.

By RANKIN KENNEDY.

In the early days of the alternating current and transformer system, the author warmly advocated its adoption on account of its many advantages. Since then it has been generally adopted, in a very modified form, and in some places with undoubted success. But if the present practices are narrowly investigated, it will be found that many of the advantages claimed for this system are not obtained by the consumer of electrical energy.

That individual is perhaps worse off in an alternating current supply than he is in a continuous current supply district, and that for many reasons, one of them being the subject of this communication, and for those reasons the author, although still in favour of alternating currents wherever they can be employed so as to attain their advantages, is decidedly averse to their use for public supply, according to what is known as the best practice in this line of electrical engineering.

Passing over in the meantime the other objectionable points in present practice, the question of choking coils *versus* resistances may be considered.

The advantages of choking coils over resistances were claimed no later than the last B. A. meeting, by Prof. S. P. Thompson, and so far as his claims went we may readily admit them, but as a public instructor whose deliverances are accepted, he ought to have limited them by certain qualifications, for it all depends on its position in the circuit whether a choking coil has any advantages over a resistance from the consumer's point of view.

A choking coil saves nothing more than a resistance if the coil is on the consumer's side of the meter. The coil may reduce the pressure on the consumer's apparatus, but he still has to pay on his 100 or 110-volt main pressure, so that although he is using only 50 volts, he is still paying for 100 volts.

But the supply company gains enormously by the use of chokers, for the energy is saved to them by the use of these coils; they reduce the load on the dynamos while yet the full pressure remains on the consumer's meter.

It is commonly misrepresented to consumers that by using a choker instead of a resistance they do not waste energy; certainly they don't waste the energy of the supply, but they do most certainly make him pay for the energy saved to the company, or works, and which he does not use.

The lesson to be taught to consumers is this: if the supply is too high in pressure for any purpose for which it is to be used, reduce it by a transformer, never use a choker except for very small reductions.

Why the Board of Trade measuring department should blink these facts is a mystery. They carefully look into one per cent. errors in meters, &c., while right under their nose consumers are paying for from 20 to 30 per cent. more energy than they actually use in many cases.

It may be said the consumers are to blame themselves for using chokers instead of transformers; quite so, but consumers are not yet educated up to that point, and as supply authorities do not put them up to the wrinkle, and professors teach the saving in chokers without qualification, it is time now to raise the question.

This question involves the meter question.

The choker is a gift horse we may be pardoned for looking in the mouth, unless it is placed on the supplier's side of the meter, and that meter is an alternating energy meter, not a current meter like the Schallenberger; if a current meter is used then it matters not where the choker is, it saves nothing to the consumer.

In any case, the choker cannot be held up as one of the advantages of the alternating current unless it reduces the readings of the meters. If it does not do that, the consumer may as well use a resistance, but he is always safe in using a transformer and thereby securing any savings for himself.

From the supplier's point of view the choker is a fine thing. If everybody used a choker, from 100 to 50 volts, the suppliers would be paid exactly twice over for the energy supplied.

AMERICAN STREET RAILWAY INVESTMENTS.

Under the above title our contemporary, the *Street Railway Journal*, publishes a large volume for the use of investors, capitalists and others, which contains particulars of all the street railways in the United States that it has been able to secure, about a thousand in all, more prominence being given to the larger cities. For all places of over 50,000 inhabitants there is also given a condensed statement of municipal statistics having a bearing, more or less upon the value of the city for street railway operation.

Thus, for Columbus, O., there are given the population in 1880 and 1890, showing a growth of 71 per cent., from 51,647 to 88,150, the geographical location and political standing as capital of the state, the railroads, a list of the city industries, banking capital and assessment valuation and municipal debt, also the tax rate. Then follows a description of the street railways and statement of finances and equipment.

A map is given of the city, and of about 40 other cities, showing the tram systems. One thing strikes us forcibly, the great extent of tramways in America. This, of course, is due to two facts: first, the towns of America are straggling; Chicago, for example, which has a population of only 1½ millions, has an area of 180 square miles, and may be compared with London with its 120 square miles in Registrar-Generals area and over four million of population, or the short million in Greater Manchester in an area of probably much under 50 miles. Secondly, American streets are generally very badly paved, and such things as omnibuses are altogether out of the question.

Thus it is at Columbus we find 68 miles of track, extending over eight miles in one direction of the city, and seven miles at right angles, with branches and parallel lines in the thicker parts of the city. Similarly at Grand Rapids, Michigan, an area of about 4 miles by 3, contains only some 90,000 inhabitants, or about that of Halifax, and has 44 miles of track. In both these cities and in so very many other places, large and small, the motive power is electricity. Even little places of a couple of thousand inhabitants are electrically supplied, and all this has been done since about 1888. Towns which could not support horse roads find paying traffic for electrical lines. Horse roads are being converted into electrical lines, and many lines are being built between town and town, while more than 20,000 cars are now in operation under nearly 10,000 miles of overhead wire. Cable roads hold their place, it is true, where already existent, and a few new cable roads are under construction, but horses are going out altogether. Though we have indicated above two of the causes that have favoured the construction and growth of tramways generally in America, to which may be added the overhead trolley wire which, as we pointed out in a recent issue, seems to offer the only present available means of successfully working street lines, it by no means follows that a similar growth should not take place here. Railway statistics show that the passenger traffic of English railroads is greater in the number of its journeys than that of America; that, in fact, an Englishman travels about three times to each journey by the American, though he does not travel so far at a time. If our towns are less straggling than the towns of America, there are certain electrical advantages connected with such compactness, while for traffic between town and town, such as is now carried on by the Manchester, Oldham, and Bury steam tramways that keep up a service between Manchester, Oldham, Bury, Heywood, Rochdale, Royton, Shaw, and Castleton by steam power, England is particularly well suited for the electric tramway. The towns of Lancashire, of the West Riding of Yorkshire, of the Potteries, of South Wales, and of the so-called Black Country, and of Durham, lie thickly within small distances of one another. Large districts of most of these towns border upon the roads rather than upon the railways, and are by no means always easy of access from the stations, nor always well served by the railways. For all such the electric line offers facilities, and we are convinced that whole districts in England only wait the coming into their midst of such lines for success to follow. Take for example the Fen districts. Throughout a large portion of the fens the roads have along one or both sides a wide strip of grass; this is termed the "cess," and upon this cess it is obvious that a light railway or tramway could very well be constructed. Such a line, worked by ordinary steam locomotives, was constructed some years ago from Wisbech to the outlying villages of Upwell and Outwell. Mixed trains of goods and passengers were run, the waggons of the Great Eastern Railway being sent along the line, which was of standard gauge. The trains stopped where required to pick up goods and passengers, calling, we remember, at a mill for some sacks or other things. English railways, made so largely in the early days of railways, did not follow the old inhabited routes, but went across country and so shut themselves off from a large amount of traffic. The old routes—the coaching routes—became neglected and decayed, but the old routes have sprung up again, and have been enlivened very largely through the influence of the cycle. The districts they pass through have become consumers of goods, and all this has its share in rendering possible the electric tramway for country work, while there is no question as to its need for the towns in ordinary passenger traffic. It is well recognised in America how the horse has been superseded in tramwork by electricity, with advantage to both the horse and to the shareholders. But how has this been done? We think there can be no doubt of the predominant factor being the power to use the overhead wire. Without this the electric street line of America must inevitably have proved a failure. There is, it is true, a dryer climate to contend against than we in England are accustomed to, but any conduit system must have failed amidst the dirt and dust of poor roads. Now, there is nothing yet in sight which offers any prospect of success that can touch the overhead system, and if we are to have electric tramways in England this is the system that must be adopted pending any better system being invented. It hardly seems worth while waiting any longer for the hoped for development of something sightly in order that the poles may be avoided. The very general objection to the overhead system has now held the ground sufficiently long for it to be asked, Is there any practicable alternative? To this question there is no reply. Are we then to neglect any longer to occupy the field in which there is room for an enormous business? The electric lines already operated in this country afford proof that we are in no sense second to America in the engineering of electrical traction. We have but to decide, and the demand for plant will be readily filled by existing firms, some of which have already proved their competency in railway work. Altogether the outlook should be encouraging to manufacturing engineers, and men of capital may in confidence invest in electrical lines. The con-

version of existing systems seems to offer a first chance for introducing electrical motive power and proving its financial benefits. Once this is shown there will be much encouragement for the construction of entirely new lines using electricity from the commencement, and this should occur in places where horse traction has, perhaps, failed. There are thousands of people, who, while regretting the cruelty inseparable from horse traction, still use horse cars. But these same people would give preference to an electrical car if they had a chance, and the experience of America is that where horse and mechanical traction are in competition, people prefer the mechanical. Unless we accept the overhead system, with such modifications and improvements as English ideas may suggest, we are left only the cable road and the steam engine. The latter is out of the question, at least for towns, as it is a nuisance, while the cable roads have numerous disadvantages, a serious one being the travelling or bunching of the cable, and uncontrollable cars in consequence. Against the electrical system there is but the one objection on the score of appearance. This we may now disregard. It can, at least, be said that so long as we permit the existence of the railway bridge at Ludgate Hill, when infinitely more comely structures can be built to serve the purpose, there is small room for objecting to neat poles and wires.

With the introduction of the cable system in San Francisco, Chicago, and Kansas City, gross receipts doubled and trebled, and working expenses fell from 80 per cent. to 60 per cent. of the gross receipts, and good dividends were earned. But the cable system has only been found suited to a heavy traffic, and horses still formed the chief motive power up to six years ago, since when electricity has been so wonderfully developed, and American investors appear to be turning to this class of investment. To make public a knowledge of where these investments are to be found is the object of the volume before us, but it should equally serve to point out to engineers and financiers on this side what a lot of work there is to be done before we come up level with America in this matter of tramways. The importance of the subject to electricians is very great. At Liverpool, it is true, there is the electric railway in successful work, but it is not on every tramway route that there can be afforded a costly overhead structure to enable the conductor to be placed below the cars, for really that is what has been done at Liverpool. Had the overhead system of conductor been selected, there is no reason why the old existing tramway should not have been used on which to run electric cars. But as the conductor could not be put overhead by itself, it has been put there all the same, and covered up by a costly steel viaduct. So at least say some people, and it looks very much so to ourselves. Then, again, in London, we have got the whole train running in the conduit. As we must have a conduit for the conductor, and the ordinary conduit with car on the surface is not particularly successful, we have put the car into the conduit; but at what a cost! In each case we have concealed the conductor—a veritable case of straining over the proverbial gnat. Now, if our electric lines pay when so very greatly overloaded with structural expenses, what may we not expect with surface roads?

THE DISEASES OF DYNAMOS.

II.

B 1.—Heating of Armatures.

Cause 19.—Moisture in armature coils or between commutator blades.

Remedy.—Dry out by gentle heat. Armature may be dried by a current sufficient to heat the wires. Commutators with paper or asbestos insulation leak after being wetted, and will cause heat unless dried off.

Cause 20.—Eddy currents in iron core of armature; core hotter than coils after a short run.

Remedy.—There is none; bad design, core not sufficiently laminated, or laminations not sufficiently insulated. A new armature is required in such cases.

Cause 21.—Friction heat from journals may heat armature by conduction.

Remedy.—See B 3.

B 2.—Heating of Field Coils.

Cause 22.—Excessive current.

Remedies.—(*a*) Wind on more wire on field coils, or rewind with finer wire if a shunt machine; or, if a series machine, shunt a portion of the current across the field coils. Tests should first be made to ascertain if coils are not leaking or short-circuited by moisture or otherwise. If short-circuiting exists, tests will show a reduced resistance.

B 3.—Heating of Bearings.

Cause 25.—Not enough, or poor quality of oil.

Remedy.—(*a*) Supply plenty of good clean oil and see that it feeds properly. Oil should be very best mineral oil, filtered, clean, and free from grit. Be careful not to flood oil over commutator or brush insulation. As it will accumulate copper dust, char, and make short circuits.

(*b*). Castor oil, vaseline, or other heavy oil to cool hot bearings, until machines can be stopped, when the bearing must be scraped up smooth and cleaned.

Cause 26.—Dirt, grit, or other matter in bearings.

Remedy.—(*a*) Flood bearing with clean thin oil until run is over, and carefully clean oil from commutator or insulation, if any.

(*b*). When stopped clean bearing thoroughly.

Cause 27.—Rough journals or bearings.

Remedy.—Must be turned up true and smooth in a lathe, and readjust bearings.

Cause 28.—Journals too tight.

Remedy.—Slacken bolts of caps, pack up and adjust, or turn journal down, or scrape open the bearings until dynamo rotates easily by hand.

Cause 29.—Bent shaft.

Remedy.—Must be bent back approximately straight, then trued up in lathe, and bearings carefully refitted.

Cause 30.—Bearings out of line.

Remedy.—Loosen foot of bearings, centre the armature in the field, and fit bolts in new position by drawing the bolt holes to the side required.

If one bearing is too high, plane or chip off sufficient to lower it, if one is too low pack it up with thin sheet metal.

Cause 31.—End pressure.

Remedy.—(*a*) See that the armature has end motion and that shaft is not bound between collars, if no end motion, file or turn face of collar or bearing until a little end motion is obtained, end pressure is sometimes caused by armature being out of the field at one end, in this case either the collars or bearings must be moved until the armature is in the field equally at both ends. If the armature is free to move endways and is either a ring or drum armature, it will be pulled into the field if out of it slightly, and thus it will find its own position of equilibrium if the field is excited and it is free to move. A disc armature must not be allowed much end play, and must be very carefully centred between the poles to obviate end thrust.

Cause 32.—Tight belt. A belt which is too narrow for its work must be worked very tight, and this causes heating of the bearing next to the pulley.

Remedy.—Get a broader belt and pulley and run with some slack on the up-side of a belt.

[Note.—All belts should be run with the tight or pulling side under.]

Cause 33.—Armature out of centre of field. Some dynamos, such as single horse-shoe, upright or vertical inverted machines must be adjusted to balance the pull of the magnets; a vertical upright horse-shoe field pulls the armature down if it is truly centered, but by placing the armature above the centre this downward pull may be abolished. In an inverted machine the armature is pulled up if truly centered, and hence its weight may be thus relieved from the bearings altogether, and this is taken advantage of in many machines. An armature may be slightly out of centre in a line parallel with the magnetic flow in the field without unbalancing to any appreciable extent, but if out of centre in a line at right angles to the field magnetic flow the disturbance to the balance is great and may cause heating of the bearings.

Remedy.—If due to bearings, high or low, they must be readjusted and packed up. If due to bearings being out of line with polar bore they must be aligned anew by drawing the bolt holes to one side.

Remark.—This fault is due to bad workmanship, and is a serious one if the deviation is at right angles to the field.

C.—Noise.

Cause 34.—(*a*) Armature out of balance.

Remedy.—Balance on knife edges without the pulley on the shaft, attach weights securely by screws or other good fixing to the light side; these weights must not touch the wires.

(*b*). Pulley out of balance.

Remedy.—Get a balanced one or get the faulty one balanced in the usual way.

Cause 35.—Striking of armature on field may be due to loose wire or heaving up of the coils.

Remedy.—This is a serious trouble and one due to exceedingly bad design and workmanship combined; in any case, the armature must be re-banded with new steel wire bands and plenty of them.

Cause 36.—Knocking of collars or edge of pulley on bearings.

Remedy.—Armature has too much end play, reduce it by thin washers between collar and bearing, if pulley knocks move it away from bearing against which it plays.

Cause 37.—Singing or hissing at brushes.

Remedy.—A little lubrication by vaseline on the commutator and reduce the pressure of the brushes on the commutator.

Cause 38.—Loose screws or bolts.

Remedy.—Screw up tight and fix by check nut, examine all screws liable to slacking before starting dynamo.

Cause 39.—Belt joints.

Remedy.—Make joints smooth and pliable, and see that they run on right side up; endless belt should be used.

Cause 40.—Humming of the armature due to projecting teeth passing under poles. This is a fault of design and can be remedied only by having the pole horns cut away obliquely. If the teeth are made numerous, and the air space is not too small, no humming is heard with ordinary square polar horns.

Cause 41.—Belts slipping off at usual load is due to the driving pulley and the driven pulley being out of line or not square with each other, or to the two shafts being out of parallel.

Remedy.—Shift either the dynamo on its bed-plate until in line, or shift the driving pulley or shaft, whichever is easiest and most convenient.

Next article will conclude the list, under D, E, F.

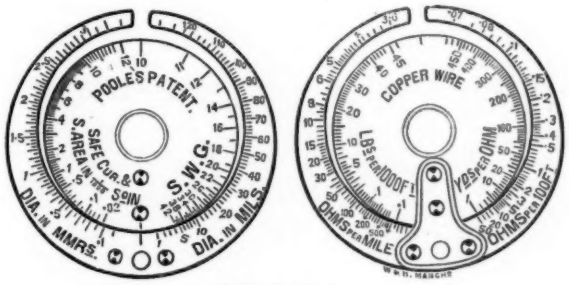
POOLE'S PATENT "ELECTRICIANS'" WIRE GAUGE.

In these days of general and electrical progress in metal working, the gauging of wires has become of much importance, and the necessity of some substitute for the clumsy slot gauge hitherto in general use has become obvious. The latter form of gauge simply shows if a wire conforms to some one or other number of a certain gauge, such as the standard or Birmingham wire gauge, but gives no other information.

Such gauges are seldom if ever quite reliable, especially in regard to the smaller sizes. To obtain the actual size of a wire recourse must be made to a micrometer gauge, or to more than one, if measurements in foreign units are required. These instruments are expensive, and give no indication of gauge numbers or other particulars of the wire such as sectional area which governs its tensile strength and its carrying capacity for electrical currents, for which reference must be made to tables given in books, &c., and these are not always available when required. Some of these tables, such, for example, as the excellent ones issued by Messrs. Glover and Co., no doubt give a large amount of information in regard to electrical and other properties of all the wires of a certain gauge, but constant reference to them is tedious and they give no details of intermediate sizes or of wires of a different gauge.

The "Poole's" gauge has been brought out to give, in one small handy and compact instrument, all the information in regard to wires, especially in regard to copper wires, which is constantly required by electricians, such information being given at a glance without calculation or recourse to vernier scales which are known to be puzzling to most people.

The *modus operandi* is very simple. The wire to be measured is passed through the opening in the outer ring (which itself gauges to No. 10 standard wire gauge) as shown in figs. 1 and 2 (which show the two faces drawn to a scale



Figs. 1 and 2.

of two-thirds full size), and drawn along one of the slots until stopped, the sizes being then shown at the points of contact of the wire with the sides of the slot which may be taken as opposite the centre of the wire. The various particulars, as detailed below, can thus be shown at once, and by use of the notes given with the instrument many other details may be easily calculated.

Scale No. 1. New Board of Trade standard wire gauge from No. 10 to 42.
" " 2. Diameter in mils $\left(\frac{1 \text{ inch}}{1 \text{ mil} = 1{,}000}\right)$ = ·001 inch.
" " 3. Ditto *in millimetres*.
" " 4. Sectional area in $\frac{1}{1{,}000}$ of a square inch.
" " 5. *Safe current* of copper wire at 1,000 ampères per square inch.
" " 6. *Resistance in legal ohms per* 1,000 *feet* of pure copper wire at 60 degrees F.
" " 7. Resistance in legal ohms *per mile* of pure copper wire at 60 degrees F.
" " 8. Length in *yards per legal ohm* of pure copper wire at 60 degrees F.
" " 9. Weight in *pounds per* 1,000 *feet* of pure copper wire at 60 degrees F.

From the above it will be seen how very comprehensive this gauge is, and which, except for very important purposes, should dispense with references to electrical tables.

The limits chosen for the gauge as shown above were adopted because it is very seldom that single wires larger than No. 10 S.W.G. are used as conductors, those of larger capacity being made up of smaller wires stranded together, so that by gauging one of these and multiplying or dividing by the number of strands, the particulars for the whole number may be nearly obtained.

Certain special notes are appended to the sheet of instructions by the use of which the gauge may be made even more comprehensive.

REGULATION OF PHASES IN WORKING WITH ALTERNATING CURRENTS.*

By C. L. IMHOFF (of Charlottenburg).

A disadvantage of the alternating current system is that on introducing into a circuit apparatus with self-induction, *e.g.*, motors, transformers, coils for arc lamps, &c., there occurred a more or less considerable displacement of phases between the current and the tension. Hence not merely the capacity of performance of the generating machine, but also the energy conveyed by the lead at a certain loss of tension is reduced, and consequently the installation is rendered more costly. All the experiments hitherto undertaken to meet these unpleasant properties by the introduction of condensers parallel to the external circuit have failed, from

* *Electrotechnische Zeitschrift.*

the impossibility of preparing a dielectric sufficiently certain for practical purposes.

Mr. Mordey (Electrical Review, 1893, Vol. 32, p. 242) has on the occasion of a discourse delivered before the Institution of Electrical Engineers, on testing alternating current machines, published two curves showing the behaviour of synchronous alternating current motors which are extremely worthy of notice, and which point out a new way to reach the desired object. From these curves, which are reproduced in fig. 1, it follows that a synchronous alternating motor,

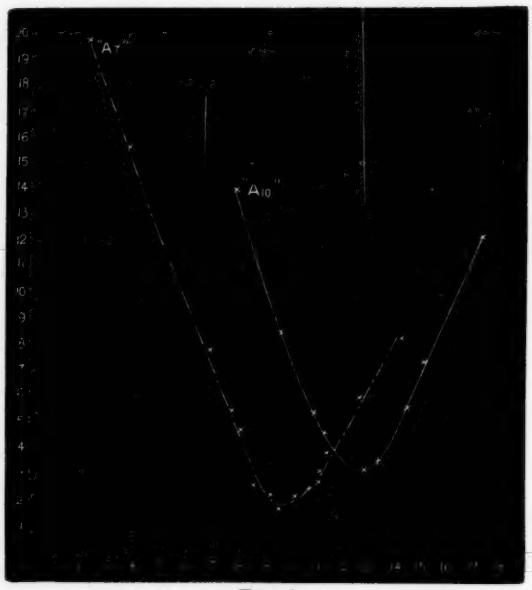


Fig. 1.

according to the regulation of the strength of the field, acts either as a choking coil or as a condenser.*

This extremely valuable property of synchronous motors may be utilised by connecting one or more motors to the distributive net (whether in the central itself or at any points whatever of the external circuit) to render harmless the influence of the displacement of phases, whether due to self-induction or to long leads or cables.

Machines which are intended to fulfil this purpose may be appropriately named phase-regulators, corresponding to the expressions phase-meters or phase-indicators.

However, to avoid in large distributive installations the introduction of a new intermediate member in the working of the machine, and the unpleasantness therewith connected, we may use the arrangement shown in fig. 2, which dispenses

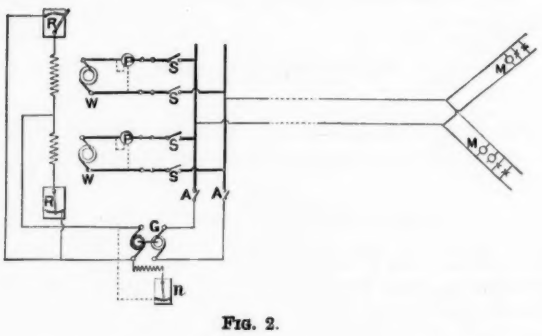


Fig. 2.

with the installation of a special phase-regulator, and which, in addition to simplicity, possesses that of cheapness.

W, W, are alternating machines which act either singly or conjointly upon a distributive net, V. The excitation of these machines is effected in the known manner by a continuous current machine, G, driven either by belts or by a small battery of accumulators at the station.

This latter is distinguished from previous constructions by the feature that besides the collector it possesses two sliding rings to give off or to receive alternating currents.

If the total machinery is set in motion, in the first place the alternating current tension of the driving machine, W, is brought to its normal magnitude by means of the resistance-regulator, R, and that of the exciting machine, G, is by the aid of the by-closure-regulator, *n*. Then the moment of the synchronism of both machines is watched for by means of a phase-indicator, and the exciting machine is connected by the switch levers, A, A, to the connecting plates of the main machine. At the same time the band transfer for the exciting machine, or the accumulator current serving for its propulsion, is switched off. The exciting machine then runs as a synchronous alternating current motor, and besides the continuous current energy can, in case of need, furnish mechanical power outwards, *e.g.*, for working ventilators, pumps, &c.

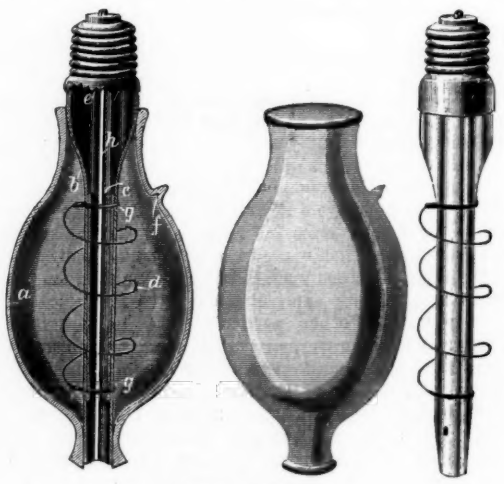
The phase meters, P, introduced in the leads of the different machines, show whether there exists a difference of phase between the several machines and at the same time between the current and the tension, and if so in what direction, that is, whether the current remains behind the tension or is in advance of it. The equalisation of the differences of phase between the several alternating machines is so regulated by the resistances, R, and that between the current and tension by the resistances, *n*, that the machines always work under the most favourable circumstances.

The great advantages which phase-regulators secure as regards economical working and decrease of the outlay for installation, will secure their rapid and certain introduction at alternating central stations.

THE TURNBULL INCANDESCENT LAMP.

In our "Notes" last week, we gave the New York *Electrical Engineer* credit for the remarks commencing: "Although no special advantage, &c.," down to "approved type of lamp." This was an error, however, as they were really our own critical remarks regarding the lamp. The accompanying illustrations (taken from our New York contemporary) show the incandescent lamp which was devised by Mr. J. W. Turnbull, of New Orleans. Fig. 1 is a half size sectional view of a 32 C.P. lamp, while fig. 2 shows the bulb and the stopper in detail.

The bulb is moulded to an exact finish with ground sockets



Figs. 1 and 2.

to fit the stopper, *b*. The sockets are ground by a tool the exact counterpart of the stopper, which grinds both of the sockets with the same movement and at the same time, thus securing a perfect fit between the stopper and the bulb.

* According to a communication from Dr. Silvanus Thompson, the General Electric Company has already made successful use of this method.

Within the stopper is a glass tube, *c*, silvered on the inside, and acting as a reflector. The carbon may be either coiled or straight, and is supported on collars as shown at *g*, and the base, *e*, is either sealed or sprung on the end of stopper. After the space between the tube and the bulb has been exhausted, the seal, *f*, is left long enough to admit of its end being easily opened to refill the vacuum chamber with air, so as to remove the stopper when necessary, to put in a new carbon or repair the lamp. The collars, *g*, that support the carbon, are electrically connected with the base of the lamp by means of the wire, *h*, and a metallic grease or paint, the latter acting as a conductor and dispensing with leading-in wires.

THE KRUEGER THEATRE ARC LAMP.

This lamp was designed, and is especially adapted for use in theatres, halls and public buildings, and is claimed to be the best means for obtaining brilliant lighting effects for stage work. It takes the place of the calcium light, and is stated to be superior to it in many respects, as it is easy of transport, and far more economical.

In the accompanying illustration the lamp is shown

attached to its supporting stand, equipped with a silvered parabolic reflector; but the lamp is so arranged that the reflector can be quickly and easily removed, and a lens box or Olivette box substituted for it, making it possible to use a single lamp for varied effects.

The illuminating power of the lamp is said to be 3,000 candles, and owing to the simple but ingenious mechanism, the light is maintained very constant. The lamp is practically noiseless in its operation, and owing to the entire absence of any devices depending upon gravitation in the regulating mechanism, it can be inclined to any desired angle without interfering with its operation, and without any re-adjustment.

In operating the lamp, connection can be made direct to the supply wires of a 110-volt constant potential lighting system, observing that the current passes in the right direction through the carbons, and under these conditions the rheostat in the perforated cone at the base of the lamp will reduce the current passing through the lamp to the proper strength.

The lens box is used when it is desired to concentrate the rays of light more or less according to adjustment. It is very useful in cases where it is desired to throw a strong beam of light upon a moderate sized object upon the stage, or to follow an object in its movements.

The Olivette box is used when a uniform dispersion of light over a considerable area is desired, which result is secured by means of a ground glass front. In front of the ground glass a colour frame is provided, open at both sides, so that frames can be slid through in succession, and the colours changed without showing the white light.

The Krueger Theatre Lamp is manufactured by the Western Electric Company, of Coleman Street, E.C.

REVIEWS.

**Outlines of Electrotechnics. For Practical Use, for Students of Electrotechnics, and for Private Study.* Drawn up by Heinrich Kratzert, Engineer and Teacher of Electrotechnics at the Royal and Imperial Trades' School at Vienna.

Part II.—*Transformers, Accumulators, Electric Lighting and Transfer of Power, with especial Reference to Electric Railways.* Leipzig and Vienna: Denticke, 1895.

This work must be recognised as admirably clear, both in its description and its numerous (281) well executed illustrations.

Its first section is devoted to an account, theoretical and practical, of alternating, polyphase, continuous current, and mixed transformers.

The second section is concerned with accumulators, or, as the author styles them, collectors. He concedes that for many purposes they possess decided advantages, especially for electro-chemical work and the transmission of power. On the other hand, he notes as disadvantages the heavy initial outlay, the loss in electric work by its transformation in the accumulator, and, lastly, the circumstantiality of the work.

The third section, the most extensive in the book, treats of electric lighting, regulators, glow and arc lamps, auxiliary appliances, the distribution of current, leads in the open air, in buildings, or under water. The advantages of electric lighting, as compared with gas, &c., are duly enumerated, but as they include nothing which is not fully known and admitted, they need not be here recapitulated.

The fourth and last section of the work treats of the transmission of power. We have not yet arrived at the happiness of electrical tram-lines in London, and it may, therefore, not be out of place to cite their advantages as cited by Herr Kratzert.

1. All the accidents occasioned by horses will be obviated.
2. The car is more in the power of the driver, as in case of need he can render the car stationary at a short distance by reversing the current, even if the brake gives way.
3. Electric cars cause much less noise than horse cars.
4. The street traffic is decidedly eased by the removal of so many horses.
5. The dust and the droppings of the horses, and the frequent repairs of the pavement, are avoided.
6. In consequence of the increased speed, and the greater expedition in stopping and starting, it is possible for an electric car in a day of 18 hours to cover about 200 kilometres, or about 50 per cent. more than a horse car, even under the most favourable conditions. The cars are better utilised, and the public reap the advantage of the swifter journey.
7. The cars can be lighted electrically, and, therefore, much better than at present.
8. Space for stables and their appendages will be economised. The use of electricity will decrease the cost of scavenging.
9. The working cost is considerably lower than that of horse-lines.
10. The fares will be cheaper.

As regards No. 6, we must remember that it is very doubtful how far the speed of the tram-cars could be safely increased in London.

* *Grundriss der Elektro-technik.*

One objection to electrical—or generally to mechanical—trams seems to have been overlooked by Herr Kratzert.

If a cart breaks down on the tram line—which often happens—it is easy to get a horse-car off the rails, run it for a short distance over the road and get it upon the line again ahead of the obstruction, but with an electrical tramcar this operation would, we fear, be much more difficult.

The Practical Engineer Pocket Diary, 1895. Edited by W. H. Fowler. Technical Publishing Company, Limited, 6, Victoria Station Approach, Manchester.

The present is the sixth issue of this very useful book. Besides corrections there has been added a specially compiled table of piston constants for calculating the indicated horse-power of engines, the diameter of the cylinder in inches (advancing by one-eighths from 10 up to 100 inches), and the piston speed in feet per minute (ten speeds, from 100 up to 1,000) being given.

Central Station Book-Keeping. By H. Foster. Published by W. J. Johnstone & Company, Limited, New York.

The author in his preface submits that companies are not by any means advised to throw up their present system of accounts and adopt the system advocated by him, but rather that they may supplement and amplify the present methods by the adoption of additional forms and books on the lines laid down in the work under notice. Undoubtedly, central station book-keeping is a new branch of accountancy; and, probably, Mr. Foster is first in the field to deal with the subject in a comprehensive manner.

In the introduction to the work, Mr. Foster refers to a supervision of accounts of electric companies by the Gas Commission of Massachusetts, and points to the success that has been obtained by the Commission in developing a very fine system of accounts. He is somewhat severe upon the book-keeping of electric supply companies in the United States, but in this country, however, it might be borne in mind that the majority of central station accounts are under the direct supervision of the Board of Trade, and are thereby compelled to be up to a very high standard of efficiency; it is generally admitted that the Board of Trade form of accounts leaves very little to be desired, in so far as complete summarisation of working results are concerned.

In the methods advocated for working up the data for various accounts, many novel and useful suggestions are made. It is doubtful, however, whether an attempt to combine two independent branches and records, namely, engineering details and purely book-keeping cash transactions, would be practically successful. An example of this is afforded by a "customer's ledger," in which such matters as meter readings, factors, units consumed, are recommended to appear in combination with cash transactions. An experience of this method has, in many cases, led to the withdrawal of this type of register and the adoption of a simple cash ledger, the details of the charges being relegated to the consumer's book kept by the engineering department. This tendency appears to be rather common throughout the work. The manufacturing accounts are very fully and ably dealt with, being well up to the standard of the best methods now in operation. These are a modification of a generally approved system of prime cost accounts to suit the needs of central station work. Preference, however, should be given to Mr. Foster's alternative scheme, which he calls his "store method," this being a withdrawal of stores as and when required by demand notes on the store-keeper, with the purpose for which they are wanted stated on the notes. The other method, namely, the allocating *en bloc* of the purchases of certain arbitrary headings is not commendable, as in many cases it is quite impossible to determine the uses to which the goods may eventually be put. The form suggested for application for current, contract register, &c., &c., together with the forms for the summary of the operations of the engineering department present many features of novelty. On the whole, the work may be confidently recommended to those desirous of supplementing their present records, more especially in matters relating to engineering data.

CORRESPONDENCE.

Electric Lighting at Folkestone.

In this week's issue you refer in a leading article, and in an editorial note, to what you are pleased to characterise as my "unprofessional conduct" at Folkestone. You charge me with having allowed my name to be brought before the Corporation as the author of a rival scheme, when actually the Corporation were employing another engineer. I wish to point out that your statement is absolutely false, and unwarranted by the facts, and I trust you will give the same prominence to this letter, and to your apology, as you have done to your most unjustifiable remarks.

The facts are that Mr. Baker has most strenuously opposed the original £35,000 scheme (not £30,000, as you assert), from its very inception, and long before he even ever heard of me, or I of him. On April 23rd, Mr. Baker and some of his friends convened a ratepayers' meeting, with the Mayor in the chair. This meeting was practically unanimous in its strong disapproval of the expenditure of £35,000 proposed by the Corporation, and a resolution was passed that the Corporation be petitioned to rescind its former decision, and not to adopt the scheme.

On May 10th the Town Council met, and actually adopted the ratepayers' recommendations, and rescinded the £35,000 scheme.

It was *after* this, and when, as I was given to understand by Mr. Baker, the Corporation had by its decision on May 10th dismissed its electrical adviser, that I prepared a report for Mr. Baker, showing how an electric lighting scheme could be well carried out in the area which he (Mr. Baker) had previously specified, for £12,000. On September 26th Mr. Baker laid this scheme before the Corporation, and a committee was appointed with power to consult with me, and to employ me to prepare a full report on the lines suggested by Mr. Baker at the Town Council meeting on September 26th.

In conclusion, I can only add that if, as I suppose, your paper is carried on for the benefit of the industry, rather than for the advantage of a clique, you will lose no time in making that ample apology and retraction which I have a right to demand.

Francis Hastings Medhurst.

[The comments which we made last week on the electric lighting affairs at Folkestone scarcely called for the aggressive epistle which we give above. We fear that Mr. Medhurst doth protest too much. To deal with the subject in the same order as our correspondent we would, in the first place, point out that the words quoted by him do not find a place in our remarks. That, however, is an error on which it is needless to expatiate. The important difference between us can be compressed into a few words. Did Mr. Medhurst assist Mr. Councillor Baker with a scheme prior to the abandonment of the original one and the dismissal of the engineer. Our correspondent thinks that he clears himself from "unprofessional conduct," to use his own term, by affirming that it was *after* May 10th, when the Corporation had by its decision dismissed its electrical adviser, that he (Mr. Medhurst) prepared a report for Mr. Baker. It is curious, but perhaps not unexplainable that, at the public meeting held on April 23rd, seventeen days before the so-called dismissal, Mr. Baker said "he had been in communication with an electrical engineer well known in the electrical world, and had been told by him that the Folkestone Corporation was not justified in spending more than £10,000 or £12,000." Who was this engineer? It may not have been Mr. Medhurst who was referred to, indeed, we should not like to think it was, but the inferences are distinctly unfavourable to him. The main question, however, still remains. Did Mr. Medhurst come publicly forward before the original scheme was abandoned and the engineer dismissed? It is easily answered, for at the present moment the old committee is in existence, and the first engineer has not yet received his dismissal. As a proof that the old scheme was not completely abandoned on so late a date as September 26th, it is only necessary to give the following resolution from the council agenda paper of that date :—

(2.) To re-consider the subject of the report of the Special Committee as to electric lighting which has been received by the corporation, and the scheme and matters connected with that report and incident thereto, and to make orders and to pass resolutions with reference thereto.

We said last week "that there has been no keen regard for etiquette on the part of the second engineer," this was modified by the remark that "he may have been unwittingly led into a false position." We have accepted Mr. Medhurst's invitation to enquire further into the melancholy history of electric lighting at Folkestone, and we have concluded that the views we expressed last week were remarkable for their moderation; therefore, apology and retraction are not called for.—Eds. Elec. Rev.]

Localising High Resistance Faults in Submarine Cables between Ship and Shore by Clark's Fall of Potential Test.

In reading over the criticisms by Prof. Jamieson on the test for the above object, described by me in the Electrical Review of September 7th, my impression was that I must have been unconsciously traversing ground already made familiar by Prof. Jamieson in his "Pocket-Book of Electrical Rules and Tables." This, evidently, is also the conclusion arrived at by the American *Electrical World*, which says, in its impression of October 6th inst.:—"Prof. Jamieson, in the London Electrical Review, September 14th, intimates that the method is not new, and that it is described in Munro and Jamieson's pocket-book."

On turning to page 210, referred to by Prof. Jamieson, I only find Clark's fall of potential test set forth in its simple and original form as given in most text-books, except that there is the additional recommendation that "the relative values of P, p, and p^1 be compared by the slide *null* method against a standard E.M.F. as given by Clark's or De la Rue's cell." This advice is volunteered for *general* application, *i.e.*, whether the test is to be made on ship or on shore. For use on board a *null* method is certainly necessary, but for tests on shore, my experience is that discharging a condenser charged from the two ends of a resistance, R, is preferable, since many more observations can be obtained in a given time, and a selection made, when they may be all compared and digested at leisure; for, with very high resistance faults, widely different results may be obtained, and the accuracy of the result will almost entirely depend on a judicious selection. A "*null*" method is certainly essential on board ship, but my way of effecting the result is different, as explained in the article in question.

On turning to another reference on p. 135, I find only Poggendorff's battery test described, using a Varley's "slide" resistance for the purpose. This well-known method I employ only to determine the voltage of my testing battery on board (and, possibly, also on shore, though comparison by condenser discharge is, perhaps, preferable), but I do *not* use it in order to arrive at the potential of the cable, either on the ship or on shore, because I consider it has disadvantages which my method is intended to avoid.

A very high resistance fault, under the stress of a prolonged testing current frequently, and indeed generally, varies sufficiently to make the results uncertain, without introducing additional disturbing elements by putting the points P, p, and p^1, even momentarily, in contact with a high resistance. Until a balance is secured, a current of more or less strength enters or leaves the cable at every contact, disturbing the *fall* in the cable. It would not be correct to assume that the disturbance is unimportant because the resistance employed is high, for the resistance of the fault under test may be very high also. Moreover, one has not always a resistance of 100,000 units available. With 10,000 units the disturbing influence of the intermittent contact test which Prof. Jamieson, and also another of my critics, Mr. F. A. Taylor, prefers, would be much more pronounced, especially as the point of balancing would sometimes be nearer to the zero end of the resistance coils. Again, it may easily be that the electrician does not happen to have a sufficient number of Clark's standard cells wherewith to balance the cable potential by direct contact with the resistance coils through which the standard cells are working. Even were he so fortunately situated, he may with reason hesitate before allowing a battery composed of Clark's cells (whose special value arises solely from their reliability as absolute *standards*) to circulate permanently through 10,000 units, and while the balance is being arrived at, to discharge themselves at every contact into the cable through a portion only of this resistance, or, it may be, receive a charge from the cable. Knowing that by whatever amount the constancy of the standard cells is affected, to that extent will the results at the two ends be incomparable. I don't suggest that these points render the test valueless, but they are weak in principle, and if the resistance of the fault be great, they vitiate the result.

The method described by which the end of the cable on board ship is permanently connected to one side of a well insulated condenser, and its potential measured by the *null* method devised by Lord Kelvin for comparing capacities, is free from these drawbacks, and is for this particular purpose novel, I think, *in its application*, though not, of course, in principle. I therefore thought its description would be interesting and useful to others having occasion, like myself, to localise high resistance faults from time to time from a cable-repairing steamer. The resistance of an ordinary Wheatstone's Bridge is sufficient, although slide resistances are more convenient.

The requisite fall of potential readings on the cable may be obtained in 10 or 15 minutes, but should readings differ in a manner indicative of frequent change of potential at the fault, prolonged readings would be desirable. Under moderately favourable conditions, when the resistance of the fault was 10,000 units only, the whole test has been made in 20 minutes from the time of applying the testing current to the cable, and very satisfactory results obtained.

Mr. F. A. Taylor thinks that I "overstate the demerits of the ordinary marine" galvanometer when I speak of it as unsuitable for measuring a discharge from a condenser. I certainly do think it is *quite* unsuitable for that particular purpose, since, however perfectly the galvanometer suspension may be balanced, the throws are too large when in the direction of the ship's roll, and too small when opposed to it; and, moreover, are too abrupt to be read with certainty.

J. Rymer-Jones.

Harmonic Call Bells.

May I be permitted to remark that Mr. S. D. Mott's proposal (in the *Electrical World*) quoted in your issue of the 19th, to ring a bell "magnetically," *i.e.*, without a moving hammer or clapper, is fully set forth in my Patent Specification No. 860, of 1891.

This patent is still maintained, and a considerable number of "bell repeaters" constructed on this principle, and as described in the Review of November, 1891 (No. 728, page 544), have been sold during the last three years.

It is, perhaps, worth while pointing out that Mr. Mott's bell as designed would not *ring*. It would only make an unpleasant noise, and to make it ring one of the pole-pieces must be removed. This seems to show that a bell does not vibrate in two ellipses, the major axes of which are at right angles to one another—as stated by the late Prof. Tyndall.

Arthur H. Bagnold,
Major, R.E.

Chatham, *October 20th*, 1894.

[It would be interesting if someone could be "drawn" on the subject of the vibration of bells. Mr. Imray, we believe, is an authority on the subject, having gone into the question many years ago over an action in which "Big Ben," of Westminster Clock Tower, was involved.—Eds. Elec. Rev.]

The Submarine Detector.

With reference to the note in your issue of 19th inst. as to the successful use of an electric submarine detector in the search for the sunken Russian ironclad *Rusalka*, I would like to state that this report has since proved unfounded.

The report was, it is true, circulated in the Russian and foreign papers, but later information showed that the apparatus was out of order, and gave "signals" without due cause; that "the divers descended and found the vessel, &c.," was only a fiction from the brain of the imaginative correspondent who first sent the "news" to St. Petersburg.

As a matter of fact nothing was found, and the investigations were continued for a time elsewhere—also without success.

They have now been abandoned for the season, but are to be begun again next spring, or possibly this winter, as soon

as the ice is formed, using a "magnetic inclinator" (?)—at least such is the prediction of the St. Petersburg paper, *Novosti*.

R. Duncan.

Notes on the Steam Turbine.

I wish to correct a mis-statement which occurred in my article under the above heading in your issue of October 12th. It was there stated that the Parsons turbine had been used exclusively in connection with electric generators. I find, however, that it has been successfully applied to all kinds of work. Amongst others, a 10 H.P. turbine is now driving the printing machinery at the *Newcastle Chronicle* office. They have also been supplied for driving the Howell torpedoes, for which purpose they are well adapted; for though the Parsons turbine is somewhat unique as regards its usual slow speed, the highest speeds are, of course, readily attainable.

Kenelm Edgcumbe.

The Starting of Motors.

In your issue of October 5th you give an illustrated description of a method of starting shunt motors under full load, which is apparently claimed by Messrs. Laurence-Scott as theirs. This is by no means a new idea. It may interest them to know that I have used this system of starting switch and resistance for the last four years, on behalf of this and other engineering firms.

Arthur Bentley.

The Acme and Immisch Elec. Works.

Efficiency of Modern Glow Lamps.

I notice in your issue of the 12th inst. a short paragraph relating to a cheap form of glow lamp known as the "Quanonne," which has lately been placed on the market.

I may inform you that I have recently had an opportunity of testing a few samples of these lamps, the results of which I append, and which appear sufficiently satisfactory to justify a more extended trial.

The method of testing adopted was that of comparing the shadows thrown by the same object respectively from a thoroughly reliable glow lamp of different make, but of the same nominal candle-power and voltages, and by the sample to be tested, and the current taken by each of four of the sample lamps individually, and afterwards the same four in parallel, measured by a Siemens dynamometer.

The question of durability remains yet to be determined. But judging from the appearance of the filament when working at slightly above their normal voltages, they do not seem to be over-run, and, therefore, should last a considerable time without blackening or any serious deterioration.

Appendix.—Glow Lamp Tests.

Description.	Nominal C.P. of each lamp.	Nominal volts.	Actual volts.	Ampères per lamp measured separately.	Average ampères per lamp working in parallel.	Watts per C.P., calculated from columns 3 and 5.
Standard lamp	16	40	41	1·35	1·35	3·42
Quanonne No. 1	16	40	41	0·8		
„ No. 2	16	40	41	1·0	0·925	...
„ No. 3	16	40	41	0·8		
„ No. 4	16	40	41	1·0		
„ four in parallel ...	16	40	41	...	0·95	2·43

Remarks.—Each of these lamps gave equal light, viz., fully 16 C.P.

F. W. Cooke, M.I.E.E.

Turning Down the Electric Light.

I really cannot understand why you should pile error upon error in speaking of my system of turning down incandescent lamps. Why it should be more extravagant to use 1½ ampères for six than for three lamps (the light given by six being exactly double that given by three) I fail to comprehend. You really miss the whole point, which is this:—If you have two 55-volt 16 C.P. lamps in series on a 110-volt circuit, and you turn them down low on the one hand by slipping into the series a third and similar lamp, and on the other hand an ordinary resistance, which has the same resistance as one of the lamps we are dealing with, then it is quite evident that in both cases the same current is being used, but that in the former case (as used by me) we get exactly 50 per cent. more light for each ampère we pay for. But I do not resort to the clumsy method of having dead lamps which can be switched in. I alter from one series to another—in a cluster of six from three lots of two in series to two lots of three in series. In my case, when turned down, the six use 1½ ampères; but if turned down by resistances, the consumption is 2¼ ampères.

If you had published my first letter to you, instead of merely criticising the subject I dealt with, there would have been no necessity for you to tell us what most people know, and which was given by me in these words: "Any plan which reduces the temperature of the filament reduces the C.P. at a greater rate than it reduces the ampèrage."

T. Budworth Sharp.

October 23rd, 1894.

[We have perfectly understood from the first what Mr. Sharp does with his lamps, and it is he who misses the whole point at issue. His arrangement of switching is, as we have previously said, without the slightest novelty, and it is quite futile to waste further time and space in discussing a useless scheme.—Eds. Elec. Rev.]

The Magnetic Properties of Asbestos.

I noticed a remark by a Mr. Swinton, in your issue of the 5th inst., that asbestos was magnetic. I have waited to see if anyone better able than myself took it up, or Mr. Swinton would correct his statement; but neither has been done, therefore I think it would be a great mistake to allow such a statement to take hold, unless it was actually so. I have tried every way I can think of to prove to myself that it contained any magnetic properties. I think what Mr. Swinton calls magnetic is simply a common electrical attraction, which can be produced by any substance more or less, and any person can try it by taking a piece of thin ebonite, 1 foot long and 1½ inch wide, and just heat it and rub it between a piece of silk or cloth, it will then lift or attract any light material, metallic or not, asbestos included. If it was magnetic it would possess the well-known properties of magnetism polarity; but, as far as I can find, it is entirely void, even when put inside of a magnetic coil.

E. Hancock.

October 22nd, 1894.

Vacuum Tubes.

It may interest Mr. Raymond to hear that I can light up vacuum tubes brilliantly by touching them against one terminal of my ¼-inch spark coil. One terminal lights them much more brightly than the other does, and this terminal is the same when the battery connections are reversed. Incandescent lamps are illuminated with a pale blue glow on touching them against this terminal. A faint glow can be seen in a tube if brought near the coil without touching it. The frequency is about 60 per second.

I have heard that a soldered joint in flexible wire is untrustworthy, even if resin is used, owing, perhaps, to the solder forming a brittle alloy with the copper. Would some reader kindly give his experience?

G. C. Allingham.

Braulik v. Sharp & Kent.

In the notice which you give of this case in your issue of the 12th, which we have only just seen, the case is rather unfairly stated. We fought this case on principle. The goods in question were supplied without an authority in July, and we accepted them on the written understanding, produced by us in Court, that they were merely "on appro." Those goods then lay *perdu*, not even unpacked, till February 8th following, and on that day we received a lawyer's letter

threatening proceedings, no statement or demand of any kind having meanwhile been made. You will therefore see that from July till February is not 12 months, still the jury held that it was not only an unreasonable time for the goods to remain "on appro," but entirely contrary to custom!!! What will your readers think of that?

Sharp & Kent.

October 24th, 1894.

THE CHLORIDE ELECTRICAL STORAGE BATTERY.

The following is a copy of the *Report of the Committee on Science and the Arts, Franklin Institute, on the Invention of Clement Payen*:—

Hall of the Franklin Institute, Philadelphia,
March 29th, 1894.

The Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, acting through its Committee on Science and the Arts, investigating the "Chloride Electrical Storage Battery." finds as follows:—

The sub-committee appointed to conduct this investigation has had this battery under careful consideration for a number of months, and has investigated the several features which are claimed to give it merit. During the larger portion of the time a number of cells have been in possession of the committee, and have been placed upon a regular working circuit under the control of one of the committee's members, where they have been subjected to exactly the same usage as a number of other storage cells of other makers and of the same size, so that opportunity was thus given to obtain the results of the performance of the chloride storage battery in regular use, which is ultimately the final test by which the utility of all inventions and improvements must be measured.

The results of this examination have led to the opinion that this battery embodies certain features of construction which prove it, both theoretically and as verified by use, to be a distinct improvement over hitherto known forms of storage batteries. In order to fully appreciate these features of improvement it will be necessary to recapitulate, briefly, a few well-known facts regarding storage batteries in general.

In all lead storage batteries, one of the objects desired is to obtain a large lead surface for small mass, as the capacity and discharge rates are strictly proportional to the amount of the surface involved. This necessary maximum of surface has hitherto been obtained in one of two ways. The earlier way was to slowly eat out the lead plates by electrolysis until they had attained the requisite spongy condition, an affair of some time and expense. The later way—and the one which is generally practiced—is to cast a frame of lead, with raised right-angled ribs on each side, thus forming little depressed squares, or to punch a lead plate full of holes, which squares or holes are then filled with a pasty mixture of red oxide of lead in positive plates, and with litharge in negatives.

For several reasons cells made in this way have always given more or less trouble in service. In the first place, after continued use or during heavy discharges, a greater or less amount of mechanical disintegration of the positive plates would often take place, small fragments of lead and lead oxide dropping down between the positives and negatives, short-circuiting them and often causing further and more serious break-up, buckling and sulphating. Even when these particles are prevented from falling, their mechanical looseness causes poor contact with the supporting lead frame, thus entailing increased internal resistance and heating with diminished output. This disintegration appears to be due largely to the fact that the lead oxide paste placed in the holes is a mechanical rather than a chemical mixture, and hence that in changing from PbO_2 to $PbSO_4$ during the action of the cell, the molecules being only related to one another in a fortuitous manner, are easily broken up and thrust apart in the change of volume attending the chemical action. This, of course, seriously limits the life of a battery and its utility for public service.

In the chloride battery it is claimed, and the committee's investigations go to confirm the correctness of the claim, that the method of construction is such that this disintegration is far less liable to occur. This mode of construction is as follows:—

Instead of cementing lead oxide paste into or against a lead framing in order to obtain the necessary active material, the latter is obtained by a strictly chemical process. Lead chloride is taken, mixed with a given proportion of zinc chloride, and this mixture is then fused and cast in small squares in suitable moulds. When thus cast the product is of whitish colour and vitreous character, being quite brittle.

For the negative plates, these blocks are about $\frac{3}{4}$-inch square and $\frac{5}{16}$ths-inch thick, and are cast in groups of four, these groups being united by portions having, say, $\frac{3}{32}$nd to $\frac{1}{8}$-inch thickness. For positives, the fused mass is cast in separate lozenges, each lozenge having a bevelled V-shaped periphery. These cut squares or lozenges are then placed in a suitable mould, and a molten mixture of lead and antimony, in proper proportions, is cast about them under high pressure, thus fixing them securely in a firm lead framing of somewhat more than the usual density. (The feature of casting under pressure is an improvement in manufacture, due to Mr. H. Lloyd, who is connected with the American makers, and the process is protected by patents granted to him.) The connecting sheets of the squares making up a group and the V-shaped bevel of the lozenge serve to make their solidity of fixation exceedingly good.

The frameworks containing the chloride castings are then placed in a dilute solution of zinc chloride, together with plates of zinc, the frames and zinc plates being alternated with one another and in metallic contact. This combination is the equivalent of a primary battery "dead short-circuited." The chemical reactions which occur result in the removal of the zinc chloride and the chlorine of the lead, and there remains finally the dense framing containing squares or lozenges of spongy lead, which plates are then "formed" in practically the usual manner.

If a section of the spongy lead thus made be examined, it is found that the metal is in a crystalline condition, and that the crystals are all uniformly arranged with their longer axes perpendicular to the surface of the plate. This provides interstices, so that the changes of volume occurring in the chemical reactions of electrolysis may take place without exerting lateral pressure upon the crystals or otherwise crowding them into a condition of break-up. These crystals are not, of course, mechanically and irregularly bound together, but are related to one another according to the laws of molecular formation, and are, consequently, much more strongly bound together than if they had been mechanically combined.

Furthermore, this crystalline structure presents the maximum obtainable surface for the given mass, an infinite number of intercrystallic channels passing all through the material, and the entire plate being of the same thoroughly spongy consistency, except in those small portions where the continuous lead framing is encountered.

The effect of this extreme porosity and surface area is to give the battery a maximum capacity for a given weight and size of cell, an item of great importance when considered with reference to the demands of traction. Very heavy discharges also can be taken from this battery, owing to the interstices between the crystals permitting changes of volume to occur without mechanical violence to the structure.

While the method of construction just described seems to accomplish its anti-disintegrating function perfectly, it has been thought best by the manufacturers, in order that there shall be no doubt about the matter, to introduce between the plates a thin sheet of acid-proof fabric, so that any small particles which might fall away could not make metallic contact with two adjacent plates and thus short-circuit the cell. The fabric chosen for this purpose is woven asbestos cloth. It might be thought that the introduction of this asbestos would considerably increase the internal resistance of the cell, but the fact is otherwise, the resistance of the cell being not appreciably higher than that of other lead cells.

This is undoubtedly due to the fact that the larger part of the resistance of most lead cells is that caused by poor contact between the lead framing and the paste placed in it. In the chloride battery this contact is exceptionally good, owing to the pastilles of chloride being so firmly bound by the framing cast under pressure as to compensate for any resistance due to the asbestos.

These batteries are, and have been for several years, operating successfully and in very large numbers in the city of Paris, as a source of current for lighting purposes. A large plant has been in operation in this city in the building of the Provident Life and Trust Company for a year past, and a very large one has been installed at the station of the Germantown Electric Light Company, where it is said to have given, thus far, entire satisfaction.

The manufacture of this battery is protected by a large number of patents of the United States and of foreign countries. The essential features of the process of manufacture, however, are covered by the patents granted to Mr. Clement Payen.

Believing that this battery is a noteworthy and meritorious improvement upon many other forms of lead battery, tending to greater durability, greater capacity without increase of weight, and making possible heavier discharges without injury, the Institute, therefore, recommends the award of the John Scott Legacy Premium and Medal to Clement Payen, the inventor.

Adopted at a meeting of the Committee on Science and the Arts, held Wednesday, June 28th, 1894.

Joseph M. Wilson, *President.*
Wm. H. Wahl, *Secretary.*

Countersigned by

Arthur Beardsley,
Chairman of the Committee on Science and the Arts.

REPORT OF THE POST AND TELEGRAPH DEPARTMENT OF QUEENSLAND FOR THE YEAR 1893.

The postal revenue for 1893 was £135,518, being a decrease of £204 as compared with the previous year; but as compared with 1891, it shows an increase of £8,075. The amount received for 1892 was the highest ever received. The telegraph revenue shows a decrease of £1,749 in 1893, as compared with 1892, and was less than the revenue of 1885. The expenditure of the post and telegraph department for 1893—£301,334—shows a decrease to an approximate with the year 1885, the nearest in amount for purposes of comparison, the expenditure being £295,892, while the revenue in 1885 was £178,973, and in 1893 £216,721; the deficiency in 1885 being £117,919, and in 1893 £84,613, a reduction of £33,306 in the latter year, or if compared with 1886, the reduction of the deficiency would be £38,716. The expenditure for 1893 shows a decrease of £20,680, as compared with 1892, and the deficiency between revenue and expenditure was reduced from £104,781 in 1892 to £86,053 in 1893, thus narrowing the gap by £18,728.

Since the last annual report (June 30th, 1893) telegraph construction has been practically at a standstill. No new lines have been erected during the year, excepting two short loops on the Racecourse (Brisbane) and Cairns Railway circuits, an additional mileage of 1½ miles of line and 8¾ miles of wire.

There are now 10,004¼ miles of line, and 17,810½ miles of wire open for public business. At the close of 1893 there were 360 stations in daily operation. In the Southern and Western Districts during the year there have been 709 interruptions to communication, the average duration being 13 hours. The principal causes of interruption have been timber blown on lines, office faults, maintenance parties at work, broken pins and insulators, crosses with telephone wires, storms, faults in railway offices, bush fires, decayed poles, and floods.

As regards telephones, there is little, if anything, unusual to record regarding the different exchanges. The working has been generally satisfactory, and the number of subscribers to country exchanges remains about the same as last year.

BUSINESS NOTICES, &c.

Universal Electrical Directory (J. A. Berly's).—Messrs. H. Alabaster, Gatehouse & Co. have now in course of preparation the 1895 edition of this directory, which embraces all connected with the electrical trades throughout the Universe. It is indispensable to all having business transactions in the electrical world. Names and addresses for insertion, corrections, and orders for advertisements should be promptly forwarded.

Aberdeen.—Prof. Kennedy has prepared for the Town Council a report on the extension of the electric lighting service in Aberdeen. He states that being exceedingly anxious, in his former report, not to give too sanguine an estimate of the rate at which the lamps would be connected, he only put down the total number at 7,000 (in the eastern district) after two years of working, and provided plant for that number, although the station and the mains were so arranged that demands for increased power could easily be met as they arose. It must be gratifying to the Council, he considers, to find that the demand for lighting has increased far more rapidly than he ventured to suggest, and that already nearly 7,000 lamps are connected to the mains, although the station has only been at work for six months. It is not possible, from the running power of the summer months only, especially in a place so far north as Aberdeen, to estimate the probable income per lamp per annum. From Mr. Murray's weekly station reports, however, there is every reason to think that even in the first full year of working the enterprise will fully pay its way without making any call on the rates, although it was hardly to have been expected that so favourable a result should be so soon obtained. As it is undesirable that lamps should be connected in excess of the number for which the existing plant will safely provide current without use of the reserve plant, and this limit is now practically reached in the Aberdeen station, he therefore advises that tenders should be obtained as soon as possible for the next instalment of the plant for which the station was schemed. The addition should consist of two engines and dynamos, each of about 200 H.P., thus raising the total horse-power of the station from 316 to 716, and the net power (with one large engine in reserve in each case) from 236 to 516. At present the maximum number of lamps (8 candle-power) which can be lit at one time (without use of reserve) is about 4,000, which is as many as there is any likelihood of being lit at once out of 7,000. The new plant would increase this to about 8,600, which would represent about 15,000 wired, or more than double the capacity of the present plant, besides allowing a larger reserve power. He estimates the total additional cost of the two engines and dynamos, erected ready for use, to be not more than £3,500. The cost of putting additional copper into the culverts would be £850. The total cost of the extension would thus be £4,350, which, with the amount already expended or contracted for, would be £29,000. The capacity of plant and mains would thus be more than doubled by an addition of less than 20 per cent. to the original cost.

An overhead electric crane has recently been set to work at the Albert Saw Mills. It was supplied by Messrs. Wimshurst, Hollick & Co.

Birmingham.—The Birmingham Electric Supply Company has appealed against the poor rate assessed on March 30th last by the authorities.

The electric current was to be switched on at the Market Hall on Tuesday afternoon last.

Blackpool.—The report of the Blackpool Winter Gardens and Pavilion for the year ended September 30th states that the installation of the electric light throughout the buildings has been carried out at the cost of £3,307.

Bournemouth.—A weekly local publication says that "a clever little invention is about to be patented by a Bournemouth man for connecting the electric light with the gas supply. All you have to do is to light the gas and turn it down low, switch on the apparatus, then switch on the electric light. As the electric light falls the gas is turned on, and *vice versa*."

A report has been presented to the Council regarding the occasions upon which the electric light has failed lately at the Gardens.

Bristol.—The chairman of the gas company, when formally inaugurating the new gasometer at Barton Hill, made some very pertinent remarks regarding electricity and gas. After showing that the increases in the company's revenue had been gradual, he said "they had no fear of the electric light. They did not suppose that their output was going to increase at the same rate as if there were no electric light, but they believed that electricity was not going to get rid of gas. There was quite room enough for both. He had always said that they could not keep out the electric light; still, it was rather hard upon the gas company that they should be asked as large ratepayers to assist a competing scheme. However, he had no apprehension that the gas company would be extinguished in their time; and, moreover, they did not mean that it should be extinguished. If by constant care and the exercise of fair ability they could keep going, he was sure they would do it, and he had every belief that they would succeed." These remarks are unusually moderate for the chairman of a gas company.

Calcutta.—Messrs. Lowden Bros., of Dundee, have received a contract to introduce electric light into the Seebpore and Howrah Jute Mills, Calcutta. The contract involves the fitting up of 1,300 lamps of 16 candle-power each.

Cardiff.—There has been a good deal of grumbling lately regarding the delay in completing the electric lighting installation. Mr. W. H. Massey was requested to report upon the matter, and in his statement he says that as soon as the contractors have finished their tests the works might be started and formally opened, but he wished to call the committee's serious consideration to the fact that the number of glow lamps wired for in Cardiff (as distinct from mere applications for the supply of current), was too small to warrant the committee using the machinery at the station constantly night and day. The Borough Engineer said that if the current was turned on with only the present applications for it, the Corporation would lose at the rate of from £700 to £1,000. He seriously advised the committee not to turn on the current until they had from 4,000 to 5,000 lamps for private consumers wired. At the present time he thought there were not more than 500. These remarks referred to running constantly during the day. The Mayor considered that some of the contractors had not carried out their contracts within the specified time, and he thought the penalties should be enforced.

The Exchange Company are introducing the electric light into the Chamber of Commerce premises.

Carlisle.—The recommendation of the Gas Committee that the Council apply for a provisional order has been adopted by the Council, the proposal of the County of London Company being opposed.

Cartmel.—A public meeting was held here last week, and a committee was formed to consider the practicability and advisability of using water-power in the district for the purposes of electric lighting and an electric railway.

Coventry.—The City Council intend charging 6d. per unit for current.

The Council have decided on the application of the Electric and General Contract Corporation, to let the question of the equipment of the tramways stand over for a month.

Derby.—The Midland Deaf and Dumb Institution new buildings, which were opened last Thursday by the Duchess of Rutland, are lighted throughout by electricity supplied from the Corporation mains. The Duchess unlocked the doors of a miniature reproduction of the entrance to the institution placed on the table of the platform, and by an electric current opened the front doors. This arrangement was designed and carried out by Mr. Stewart, the borough electrical engineer.

Douglas.—The ratepayers recently decided to negotiate with the Douglas and Laxey Electric Tramway Company with a view to ascertaining upon what terms they would be disposed to construct and work a proposed tramway between upper and Lower Douglas. The Commissioners then asked the ratepayer's committee to conduct the negotiations, and last week this committee had a prolonged interview with the directors, the result of which we have not yet been able to learn.

Dover.—The Lighting Committee do not approve of the positions suggested for the electric lamp pillars. At the suggestion of the Mayor (who is also Chairman of the Electric Lighting Company) however, they are to be altered after the light is turned on if they are not then considered satisfactory.

Fermoy.—Mr. Tomlinson has asked us to correct a statement made under the heading "Fermoy" in our issue of October 12th. He is not, though he resides at Bray, engineer to the Bray Electric Lighting Company, but is the late chief engineer to Messrs. Gordon and Co., who designed and carried out those amongst other works. The engineer is Mr. G. M. Harris.

Gainsborough.—The Albert Hall and Theatre is being extensively altered, amongst the improvements being a complete electric light installation.

Guiseley.—The new stores of the Guiseley Co-operative Society are now lighted by electricity.

Hanley.—At Monday's meeting of the Council, Alderman Shirley said the demand for electric energy was almost phenomenal. They were unable to cope with the demands for it which were made, and the committee had resolved to increase the plant.

Elphinstone Circus, which has lately undergone extensive alterations, has been lighted by electricity, four 1,000-C.P. arc lamps being used.

Hereford.—Three high town tradesmen have lately lighted their premises by electricity, the generating plant being laid down at the rear of the establishment of one of them. The plant consists of a "Hornsby-Akroyd" 16 H.P. engine driven with paraffin oil, and a 100-volt Britannia Company dynamo. This combined plant will light a 10-ampère arc lamp and 160 16-C.P. incandescents. A distributing switchboard is in each of the three establishments. Messrs. Alexander & Duncan, ironmongers, one of the firms in question, have carried out the installation. The *Hereford Times* questions the likelihood of electricity being adopted in Hereford as a public illuminant for some considerable time, as the Corporation Gas Works are comparatively new and are a profitable undertaking. It will be interesting to hear how this arrangement between the enterprising fellow-tradesmen of Hereford works, and how the cost works out.

Huddersfield.—The Town Council have refused to allow the Huddersfield Industrial Society, Limited, to carry electric wires across Buxton Road, for the purpose of lighting the society's premises in John Street. A George Street firm are allowed the privilege, and the society pleads this as a reason that the application should be granted. The council, however, assert that the traffic of the two streets is not to be compared, that of Buxton Road being far in excess of that of George Street.

Kingswood.—An accident, which caused a great deal of inconvenience, happened here on 17th inst. A farrier was driving a colt and trap into the main road from Downend Road. The man was breaking the animal in and it became restive, kicked, and bolted. In furiously turning the corner into the main road, the wheel of the trap collided with the electric lighting standard, snapping it off at the bottom end and tearing up the pavement. In consequence, it is said, the greater portion of Kingswood was in total darkness during the evening. Fortunately it was early closing day or the inconvenience caused would have been much greater. The farrier was thrown and much injured by the accident. It seems strange that a blow like this should have the effect of tearing up and snapping the electric light pillar. We should think there must have been some defect in the casting, or possibly the standards may be too near the edge of the pavement.

Leeds.—The Theatre Royal, which is to be extensively altered, is also to be supplied by electricity for lighting purposes.

Liverpool.—Mr. Alderman Smith will ask the City Council to-day to enter into negotiations with the Liverpool Electric Lighting Company for the purchase of their undertaking by the Corporation.

London.—The Whitechapel District Board have given permission to the City of London Electric Lighting Company to lay a main from the south-western corner of the Minories to the Dock House, for the purpose of supplying electricity to one of the company's warehouses in St. Katharine's Docks.

Monmouth.—A correspondent writes:—"The people here are rather amused at our mayor (Mr. Honeyfield), who, now that all is settled about our having the electric light, has taken the agency for incandescent gas burners, and is sending circulars all over the town telling the people they will save 50 per cent. in their gas bill."

Moss Side.—The question of electrically lighting the Princess Road Board School has been referred to a committee for consideration.

Newport.—The laying down of electric lighting plant is progressing. The first transformer boxes were laid down the week before last.

Portsmouth.—On Tuesday at the Town Hall was held a Local Government Board enquiry respecting an application from the Corporation for power to borrow £20,000 for the purpose of extending the electric light. The Council only sought power to borrow £6,000 at present, with which to purchase a new engine and dynamo, and the requisite street transformers. Mr. G. Ellis, J.P., chairman of the Electric Lighting Committee, stated that the cost of purchasing and fixing the engine and dynamo would be £4,500, and the balance of £1,500 would be spent on transformers, and the cable connections to the houses. The balance of the £20,000 would be required in the future for still further extensions of machinery and laying down fresh mains outside the present area. At present they had applications for 363 lamps outside the area; and when they reached 500, or could show a return of 6 per cent. on the capital outlay, they would apply for power to borrow sufficient money for the extension. They had already joined up 5,224 16-C.P. lamps, independent entirely of the street lighting, and they had applications for 1,202 more lamps within the area, besides 1,363 just beyond it.

Reading.—Messrs. Callender (who are the contractors for laying the underground mains for the Reading Electric Supply Company, Limited), commenced operations last week.

Sheffield.—Sir Frederick Mappin recently made some remarks at the meeting of the Sheffield Gas Company, to which we referred in these columns at the time, regarding the waste of money upon lighting the Bow Street Schools by electricity. At last week's meeting of the Board School authorities, one of the members asked permission to correct Sir Frederick's statements on the subject. It appears from the remarks of the member in question, that electric light has not been adopted at all for the artificial lighting of the school, notwithstanding the gas chairman's assertions regarding extravagance. The facts of the case really are that electric apparatus was being placed in the new laboratories, lecture rooms, and workshops, which were being added to the Central School in Orchard Lane. "The electric light in the basement of that building would, it was true, be not far from the heating apparatus, but it was in well lighted, spacious rooms, where there would be gas engines, dynamos, lathes, and complete workshop appliances, which had been so exceedingly useful in connection with the system of elementary technical instruction carried on at the Central School. It should be explained that gas engines would be required to drive air propellers in connection with the proper ventilation of the laboratories and other portions of the buildings, where electric motors would be brought into requisition. Electric apparatus would also be of great service for educational purposes. The first installation for the offices and one of the class rooms of the Central School was actually fixed by the elder scholars themselves, under the direction of Mr. Watkinson, who had had large experience in such matters. The cost of the electric light had, it was believed, been less than that of gas, and the instruction derived from its use had been much appreciated, not only by the boys themselves, but by employers who had afterwards found their services increased in value thereby. It had been calculated that on the plan arranged the electric light would be produced at a cheaper rate than would be possible for gas light of equal power."

Singapore.—*Indian Engineering* notes that, speaking of the report on the Hermite system of sanitation by electrolysed sea-water, drawn up by Mr. Newton, the assistant engineer, and Mr. Lindsay, the president of the Singapore Municipality, said he thought there could be only one opinion expressed on reading this report, viz., that they should convey the thanks of the Commissioners to Mr. Lindsay and Mr. Newton, whom he was glad to see had returned. They had supplied them with an admirable report from which it was obvious that this system, whatever it might ultimately become, had not yet reached that stage when any practical use might be made of it here, but he had no doubt the matter would engage the attention of the engineer's department, so that if further advances were reported they would be able to re-consider the matter.

Stafford.—Both gas and electric lighting powers are in the hands of the Corporation. Last week the local functionaries assembled at the electric light station, where a memorial stone was then laid by the Mayor. Dr. Jno. Hopkinson, the engineer, was among those present. £20,000 has been borrowed for the scheme, and the three-wire system is the one adopted. No street electric lighting is to be done at present.

Telegraph Rates to the Cape.—We understand that the Hon. S. R. French, Postmaster-General for Cape Colony, is on a visit to England with the object of endeavouring to induce the Home Government to include the colony in the Postal Union, and also, if possible, to get a reduction in the cost of cablegrams.

Whitehaven.—A Local Government Board inquiry was held here on Wednesday, last week, regarding the application of the Town and Harbour Trust for sanction to the borrowing of further monies for electric lighting purposes. The sum to be borrowed is £6,304. About half of this is for works already executed, which were extras on the original contract and included the following items:—Extra public lamps for Hensingham Road, Arrowthwaite, and in the town, £492; extra domestic main round by Irish Street, £389 2s. 11d.; three feeders to different points, £1,851 10s. 2d.; extra domestic services beyond those sanctioned, £260 5s. 10d.; wiring up of the harbour, £66 5s. 3d.; cables in stock, £140 6s. 8d. prime cost. The extra plant was necessitated by the great demand there was for current beyond what it was anticipated there would be for some time. The additional plant now proposed to be acquired consists of a pair of engines and dynamos, £1,500; £30 for water-pipes; switchboards, alterations to connections, and instruments, £60; conductors, branches, and house service, £1,750; meters, £500; additional batteries, £50; sundries, £20. This was Dr. Hopkinson's own estimate. The whole of the public lighting of the town is now done by incandescent lights. There are in all 429 street lamps, equal to an average of 465 lamps of 16 candle-power each; 104 harbour lamps, equal to an average of 172 16-candle-power lamps. There are 63 private installations, the total lamps supplied being 1,395 16-candle-power. That brought up the total to 2,032 16-candle-power lamps now installed. The dynamo output at present at the station is 2,000 16-candle-power lamps, with a small battery equal to about 300 16-candle lamps for one hour. There are 3,400 lineal yards of domestic cable laid. Applications had been received from 13 additional consumers. These they could not accommodate without this further plant. They would equal 116 16-candle-power lamps.

Wimbledon.—A chairman of a local authority, by the casting vote which he possesses, often exerts a very powerful influence. This was the case with the chairman of the Wimbledon Local Board the other day. Half of the members wanted to purchase 50 of the newest design of oil lamps, and considered electric lighting too dear for their district, but the other half did not want them, doubtless they wished for something better. We think the chairman acted very wisely in giving his casting vote to the latter party, thereby resolving that the oil lamps are not to be purchased. No resolution was passed, however, in regard to electric lighting.

Windermere.—The Electric Supply Company have asked the Local Board whether they favour the company's intended application for a provisional order. The Board have decided to wait until the Clerk has secured a copy of the order from the Board of Trade showing what the company commits itself to.

Windsor.—A new firm of electrical engineers and contractors has been formed here under the style of the Windsor Electric Installation Company. The company has engaged the services of Mr. A. E. Farrow, who was, until recently, the local manager for Messrs. Roger Dawson, Limited.

Worcester.—At the electrical exhibition the stall of Messrs. Verity & Sons, is one of the largest. The firm have on

exhibition a varied show of fittings, including electroliers, pendants, hall brackets, ceiling fittings, also a variety of other electrical accessories.

St. Michael's Church was, on Sunday week, electrically lighted for the first time.

Worthing.—The town has been visited by Prof. Alex. B. W. Kennedy for the purpose of making his report regarding the proposed electric lighting.

Award.—We learn that "Oerlikon," who are licensees for the three-phase system of the Electrical Company, Limited, exhibited these machines at Lyons, and obtained the gold medal (highest award).

Bankruptcy.—Under the failure of William David Gooch, electrical engineer, Victoria Mansions, Westminster, accounts have been filed showing liabilities £4,365 19s. 8d., and no available assets. The bankrupt states that from 1885 to 1888 he carried on business on his own account at 2, Victoria Mansions, during which time the bulk of his present indebtedness was incurred in connection with speculative electrical contracts, &c. Since 1888 he has had occasional engagements as consulting and electrical engineer, and for the last five months he has been in the employ of an electric welding company, his fees or salary therefrom averaging about £6 per week. The failure is ascribed to the losses on the above-mentioned speculative electrical contracts. The public examination is fixed for November 8th.

At the Halifax Bankruptcy Court on Tuesday, a receiving order was made in the affairs of Frederick Leopold Wovilliard-Rigg and Harry Ernest Scarborough, trading as Wovilliard, Scarborough & Co., electrical and mechanical engineers, Wade Street, Halifax. The liabilities are stated to be about £500, and the assets £300.

Birmingham Central Tramways Company.—There has been a good deal of animated discussion going on at Birmingham lately between the directors and shareholders of this company. There have been numerous personal attacks emanating from certain of the excited shareholders, and the Birmingham daily papers have for the past week or more been publishing letters from persons on both sides. Some of the shareholders are desirous of getting rid of the chairman (Mr. Ebbsmith), but many are not. The directors recently called a meeting for business purposes, but the uproar and insult coming from the shareholders was so unbearable, that the directors would not continue the meeting. The shareholders thereupon held one among themselves, several of the directors remaining, and here there was a continuation of the abuse. Another meeting was held on Wednesday, when all opposition was withdrawn and a resolution passed reducing the capital of the company by one-half.

Business Alteration.—The electric light business of Mr. Wm. E. Hayne, 29, Western Road, Brighton, has lately been acquired by Mr. Thomas King, of Maidstone, and will be carried on under the management of Mr. Chas. Rawlings. Owing to ill-health, Mr. W. E. Hayne has been compelled to retire from practical work, but will act as consulting engineer, at Ebor House, Bexhill-on-Sea.

B. Verity & Sons.—This firm are very busy in their fittings and electrical accessories departments, being obliged to extend their Aston works, and put down additional machinery in order to cope with the pressure of orders. Among the principal contracts in hand for fittings are the following:—Southport Municipal Buildings, Assembly Hall, &c.; Worcester Guildhall and Municipal Buildings; Burton Town Hall and Municipal Buildings, Church Institute, &c.; Cardiff Town Hall and Municipal Buildings, St. Mary's Markets, &c., They have also some large trade orders for switches, lamp-holders, general sundries, &c.

Cable Accessories.—Messrs. Slade, Templeton & Co., of 15, New Broad Street, are devoting their attention to the meeting of emergencies of all kinds in telegraphic enterprise. In case of a cable requiring lifting and repair, they are able, at a few days' notice, to provide a ship equipped with all necessary machinery for the purpose, and they are in a position, by keeping stock ready for delivery, to supply pressing requirements of almost any kind without delay.

Change of Address.—The offices of the London Electric Supply Corporation have been removed to 25A, Cockspur Street, S.W.

Crompton-Pochin Arc Lamp.—We have received the following communication from Messrs. Crompton & Company, Limited:—"In these days when the question of improved arc lighting is now so prominently before the public, it may interest your readers to know that we have been successful with our new simplified Crompton-Pochin type of lamp in obtaining the order for the street lighting of Edinburgh. Although a large number of makes of lamps were tendered for only three were selected for trial, and of these our lamp was judged best suited for the purposes of the Corporation. The conditions of competition were not limited to the comparative excellencies of the lamps, but the question of the economical use of carbons was also taken into consideration. We believe this is the first time that a tender has been so carefully adjudicated on, so that the results in this case are especially gratifying to ourselves."

French Atlantic Cable Company.—A Dalziel cable from Paris says there is now apparently little likelihood that the proposed amalgamation of the Compagnie des Cables sous Marins and the French Atlantic Cable Company will take place. The shareholders of the latter company are using every effort to prevent the combination being carried through.

New Agency.—M. L. Barrière, of Paris (successor to the old firm of Messrs. Rheins & Barrière), has appointed Mr. G. Strauss, of 130, Queen Victoria Street, E.C., as his sole agent for Great Britain and the Colonies. M. Barrière has extensive works at which he manufactures a speciality of metal screws, terminals, and all kinds of metal turning.

New Books.—The *Electrician* Printing and Publishing Company, Limited, of Salisbury Court, Fleet Street, London, are just issuing "Electric Lamps and Electric Lighting," by Dr. J. A. Fleming, M.A., F.R.S. The same publishers also announce, as ready shortly, "Electric Motive Power," with chapters specially dealing with the use of electricity in mines for lighting, haulage, pumping, coal-getting, &c., by Mr. Albion T. Snell, M.I.M.E., M.I.E.E.

Price Lists.—The Electrical Company, Limited, have sent us copies of their price lists of dynamos, motors, transformers, incandescent lamps, Dolivo measuring instruments, and the "Luna" arc lamps. These lists are well printed and illustrated, and prices are given of most of the articles dealt with therein.

The Automatic Standard Screw Company, of Halifax, send us one of their general stock price lists of terminals and screws for telegraph, electrical, and optical work. The list is fully illustrated.

From Mr. R. Applegarth we have received a circular of the "Elieson" switch which he supplies.

Messrs. Ludw. Loewe & Co., of Berlin, send us through their London agent an illustrated list of the Universal milling machines.

Sharp & Kent.—This firm has on hand at present over 51 installations, comprising all kinds and classes of electrical work, and including plant and wiring for Trentham for the Duke of Sutherland, where there will be 700 lights; also two mills to be fitted with 700 lights each, several private houses in London, and a large number of shops in the country, where the Liverpool department of the firm is exceedingly busy.

Special Electric Light Fittings.—We understand that the fittings for the Baths Club, and also those for the Bishopsgate Foundation Institute, were made to special design by a firm recently established at 2, Longford Street, N.W.—Messrs. S. Haynes & Co. This firm is endeavouring to secure the goodwill and support of the trade by confining itself to manufacturing, and does not, under any circumstances, undertake wiring contracts. The head of the firm having had experience in some of the leading houses, and being practically familiar with every process involved in the manufacture of high-class metal work, is in a position to carry out the wishes of those who need fittings made to their own designs and under the occasional inspection of themselves or their clients.

Telegraph Extension and Agriculture in North Borneo.—Reuter's Agency has received from the British North Borneo Company the following communication:—"The work of cutting the track for the telegraph line across the country continues to progress very satisfactorily. Some miles of posts and wire have already been erected on the west coast. We hear, in connection with this important work, that the track will open up some sections of land which are admirably suited for cultivation. At the beginning of the year free grants of land were made along the completed road, and now both sides are laid out in plantations and gardens of cocoanuts, plantains, mangoes, and vegetables for about a mile and a half, and new settlers are still coming in from the surrounding districts and rivers. Menumbok, on the west coast, where the Eastern Extension Telegraph Company's cable was landed, has greatly developed, a large sago factory being now under construction in addition to the three in operation, and 36 Chinese shops are doing a thriving business."

The Aluminium Company.—The subject of electrolysis has been so widely discussed, that the report of the Aluminium Company just issued will be of interest. The Aluminium Company, which set out in life to make aluminium by a very cumbersome process that was completely knocked out of the market by the electrolytic process, bid fair for a long time to come to an untimely end. However, the directors persevered, and are now in the curious position that they do not make an ounce of aluminium. Instead, they stopped their process when partially complete, and are now manufacturers of the rare metal sodium, the business in which bids fair to grow, and indeed the sodium business furnishes the chief part of the profits that are now being made, and have allowed of a dividend of five per cent. being paid on the reduced capital, the old shares of £5 having been written down to £1, and already standing at a premium in the market. But the company's chemist, Mr. Castner, has, it is said, perfected an electrolytic process for the manufacture of caustic soda. Of this process, which has been in operation at Oldbury since July, and has run ever since without a hitch, the Chairman stated at the annual meeting of the company on October 10th, that though the directors had held great expectations of the plant, it had exceeded their best hopes. "We knew," he said, "what the efficiency of the process was, we knew also that the product would be of the utmost purity, but the exceeding smoothness of the working from the first, its perfect regularity, and the great length of time during which each cell will work without cleaning or any labour being bestowed on it, viz., at least a fortnight or three weeks, were not expected." He concluded his remarks with a promise of an early reply from the managing director in one of the leading engineering journals to all the criticisms favourable or unfavourable that have appeared upon the process, stating, however, that he and his fellow directors had now higher hopes of the process than they ever had. Should these hopes be realised, as it is to be hoped they will, the Aluminium Company may be congratulated in having saved themselves by electrolysis from the very ruin brought upon them by an earlier application of electrolysis. Doubtless shareholders will welcome anything that will lead to a continuance and augmentation of dividend; it must be several years since they received anything.

The Art of Illustration.—One of the Edinburgh newspapers publishes an illustration which is intended to show the effect of the electric arc lighting in some clothier's shop-premises lately fitted up in that town. All we can see in the intended illustration is a black background with about a dozen little white patches scooped out to represent the globes of arc lamps; we do not observe any other effect. We have occasionally noticed ambitious aims at artistic blotching in some London technical journals, but we can fairly say none of them have gone so far as the Scotch evening paper referred to.

The British Electric Light Company, Limited.—In the Chancery Division of the High Court on Wednesday, before Mr. Justice Stirling, counsel appeared on behalf of a debenture holder in the British Electric Light Company, Limited, and moved for the appointment of a receiver and manager of the company. He explained that the action was at the instance of his client and other debenture holders of a series of debentures which created a first charge on the entire property of the company. The terms of these debentures were, that if they were not paid off on July 31st, 1894, the whole undertaking of the company should immediately become specifically fixed, and charged with, and applicable to provide for the principal money and interest in priority to all other debts, and that such principal and interest should forthwith become payable. He had an affidavit showing that the debenture bond—£1,000—had been presented, and had not been paid; and showing further that the interest had been in arrear for a year. In answer to his Lordship, counsel stated that he understood the company did not appear. His Lordship said there would be the usual order upon production of the affidavit of service; and an immediate appointment, subject to security being given.

The Telephone in Kent.—During the last three months, the telephone has made a great advance in Kent, and new centres are in contemplation. In a few weeks an exchange will be opened at Sevenoaks, and another at Gravesend, while it is proposed at an early date to open exchanges at Sittingbourne, Wateringbury, and Kearsney, all of which would be connected with the trunk lines. All the exchanges in the county are now connected with London.

Thomas Parker, Limited.—It is announced that the works of this company, at Wolverhampton, are nearly completed. The machinery is fixed in position, and a sufficient number of orders is said to have been secured, both home and foreign, for traction and lighting, to afford work for a considerable number of hands.

J. G. Statter & Co., Limited.—The Bedford Engineering Company have presented a petition to the courts for the winding up of this company. The petition is to be heard on Wednesday next, October 31st, at the High Court of Justice, Strand. Creditors or contributories desirous of supporting the petition should give notice by 6 p.m. on Tuesday next, 30th inst., to Messrs. Powell & Rogers, 17, Essex Street, Strand, W.C., in accordance with instructions accompanying the notice published in the *London Gazette*.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—October 26th. Tenders are wanted for fitting up the new police offices with the electric light. Plans and specifications may be seen at the office of Mr. John Rust, city architect, 224, Union Street, Aberdeen.

Germany.—November 10th. Tenders are being invited by the German Postal Authorities at Nuremberg, for the supply of 34,660 telegraph posts, varying in length from 7½ to 17 metres.

Italy.—The Municipal authorities of the town of Spoleto, Umbria, are considering the question of electric lighting, and are inviting electrical engineers to send in plans for the establishment of a central electric lighting and power station.

CLOSED.

Cardiff.—The following tenders were sent in for wiring the Town Hall and market buildings for electric lighting purposes, including the supply and fixing of all cables, casings, switch and distributing boards, &c., but not lamps and fittings, for the Corporation of Cardiff. Our readers will observe the enormous differences in the prices quoted.

Market.			
Maunsell Mercier & Co.	£198	0	0
Fergus & Co. (accepted)	185	0	0
Clay Bros. & Co....	245	0	0
Fowler, Lancaster & Co.	232	10	0
F. W. Ball & Co.	507	18	9
W. & T. Robinson, Limited	480	17	0
J. B. Saunders & Co.	483	0	0
S. Walker & Co....	610	0	0
Knapman, Hodder & Co.	740	7	6
Town Hall.			
Maunsell Mercier & Co.	264	0	0
Fergus & Co. (accepted)	338	0	0
Clay Bros. & Co.	318	0	0
Fowler, Lancaster & Co.	493	15	0
F. W. Ball & Co.	553	5	7
W. & T. Robinson, Limited	636	10	0
J. B. Saunders & Co.	678	0	0
S. Walker & Co....	705	0	0
Knapman, Hodder & Co.	994	18	6

Sunderland.—A sum not exceeding £35 has been voted by the County Council to be paid to the India-Rubber, Gutta-Percha and Telegraph Works Company for vulcanised joints in connection with the electric lighting, the sum to include lessons to be given to the men at the central station in the making of such joints.

BOOKS RECEIVED.

Central Station Book-keeping and Suggested Forms, with an Appendix for Street Railways. By Horatio A. Foster. Published by the W. J. Johnston Company, Limited, New York.

The Electric Current: How Produced and How Used. By R. Mullineux Walmsley. Published by Messrs. Cassell & Co., Limited. Price 10s. 6d.

NOTES.

The Chloride Storage Battery.—If Mr. Clément Payen is the first inventor of the chloride of lead battery, how is it that the first mention of chloride of lead and chloride of zinc was made in the Marchenay patent, and that Mr. Payen, although a Frenchman, did not patent his process in France? There is nowhere any patent for a chloride of lead secondary battery before the date of application for a patent by Marchenay. Surely Messrs. Mather & Platt, who work these patents in England, will be able to give some particulars about this strange case?

The Pacific Cable.—The *Times* correspondent at Ottawa, in a despatch dated October 21st, states that several weeks ago Mr. Sandford Fleming and Mr. W. H. Mercer, of the Colonial Office, left here for Honolulu, authorised by the Imperial Government to negotiate with the Hawaiian authorities for the purchase of Neckar Island, to be used as a landing place for the proposed Pacific cable. A San Francisco despatch says that their mission has been unsuccessful, the reciprocity treaty between the United States and Hawaii preventing the latter country from conceding any of its territory to Great Britain.

The failure of the negotiations with Hawaii for the purchase of Neckar Island as a station for the proposed Pacific cable, has given rise to varied Press comments at Ottawa. Under the heading, "British Blundering," the *Ottawa Citizen*, after pointing out how necessary for the success of the Pacific cable scheme it was to secure the island, says:—

> There is a general belief that the Canadian Government urged upon Great Britain the necessity of taking possession of this desirable spot while it was still no man's land, and months before its capture by Hawaii. The Home Government, with that incredible apathy which sometimes marks its treatment of the most important affairs of and outside the empire, neglected the favourable moment, and allowed a foreign Power to step in and seize the coveted prize. Is Great Britain unequal to the responsibilities entailed by her great possessions? Whatever the cause, the stupid negligence and procrastination exhibited in such matters as that of Neckar Island are particularly exasperating to us in the colonies, who are putting forth every effort to bring together the possessions beyond sea of Great Britain, and who expect that at least as keen an interest shall be taken in the schemes for that purpose at the heart of the empire as is felt here.

Mail advices received at San Francisco on October 24th, give the following additional information respecting the negotiations entered into with the Hawaiian Government by Mr. Mercer, of the British Foreign Office, and Mr. Sandford Fleming, one of the directors of the Canadian Pacific Railway, regarding the proposed Pacific cable. The two Commissioners ask Hawaii for a lease of Neckar Island and for a subsidy of £7,600 for fifteen years. In return they will lay the cable, and make the rate a shilling a word over the line, and a special Government and Press rate, on condition that Hawaii cede the island to Great Britain in the event of a Hawaiian annexation to the United States. The Hawaiian Government, it is added, is willing to consider the proposal if the Commissioners accept a lower subsidy, and forego the provision for the cession of Neckar Island to Great Britain in the event of annexation.

The Institution of Electrical Engineers.—The annual dinner of the Institution is fixed to take place at the Freemason's Tavern, Great Queen Street, on Wednesday, November 21st.

"The Engineering Magazine."—The editors of this excellent magazine inaugurate with the October number a "Review of the Industrial Press." The plan and scope of the work are not so complete as it is hoped to make them. What the editors have in mind is to do for industrial literature all that "The Review of Reviews" does for the political and literary field; indeed, ultimately to make the best possible review and index that can be devised. That technical journalism has grown to proportions and importance which warrant such a work, is a fact in which all can rejoice.

Obituary.—We regret to hear of the death of Mr. Edwin Clark, M.I.C.E., which has just occurred at Cromwell House, Marlow. Mr. Clark was born at Marlow in 1814, and was an elder brother of Mr. Latimer Clark. He was at one time engineer-in-chief to the Electric Telegraph Company. He worked under Robert Stephenson, and had control of the construction of the Britannia and Conway bridges. He patented the hydraulic graving dock and the hydraulic canal lift, and was the inventor of the block system of railway signalling. He constructed the famous harbour of Callao, in Peru, and carried out engineering works in various parts of the world. Retiring in 1876, he settled down to a quiet life—and consequently has not been heard a great deal of during late years—at Marlow. He was a keen student of astronomy, and was a fellow of the Royal Astronomical and Meteorological Societies.

Mr. Maxim's Flying Machine.—Mr. Maxim writes to us as follows:—"As a great number of people have written to me requesting that I should allow them to witness some of my experiments at Baldwyn's Park, I have consented to exhibit my machine in motion on Saturday afternoon, November 3rd, for the benefit of the Bexley Cottage Hospital, a very deserving institution, and urgently in need of funds. On that occasion the machine, with only the main aeroplane in position so as to be able to go out in any kind of weather, will be run over the track at a high velocity, driven by its own propellers. The large workshop will be open, and the apparatus for measuring the screw thrust and the lift of the aeroplanes will be exhibited and explained. A train leaves Cannon Street Station for Bexley at 1·45, and if a considerable number of tickets are sold, a special train will be provided. Admission by ticket, price 2s., family ticket to admit four, 6s., may be obtained from Mr. Geo. J. Gill, hon. secretary of Bexley Cottage Hospital, Gravel Hill, Bexley Heath, Kent."

Industrial Society of Amiens.—This society at its general meeting on July 30th, 1894, announced the following premiums to be awarded: A gold medal for a generator of electricity, mechanical or chemical, fulfilling the best conditions as to yield and economy. A gold medal for the best installation of electric lighting which has worked in an industrial establishment for at least a year. This installation should be more economical than gas; as a point of comparison, the cost price at an industrial establishment of 300 to 500 burners making its own gas, must be taken. A gold medal for a new and economical chemical application of electricity in the district. Foreigners are allowed to compete, except for questions which include a restrictive clause in their respect. But all the memoirs must be drawn up in French. The memoirs must not be signed. They must bear a motto, which is to be reproduced on a sealed envelope containing the full name and address of the author, and an attestation that the document has not been previously published. The apparatus must work by preference at Amiens, or in some point of the district near Amiens, within a radius of at least 100 kilometres. The competitors must send their MSS. or machines carriage paid to the president of the Industrial Society, No. 20, Rue de Noyon, Amiens (Somme), up to April 30th, 1895.

Lectures.—Before the Derbyshire Metallurgical and Engineering Association the other day, Mr. H. B. Edwards read a paper on "Electricity as Applied to Mining."

Before the Literary and Philosophical Society at Firth College, Sheffield, recently, Mr. Francis Gotch, M.A., F.R.S., delivered a lecture on "Electric Fish, or the Power of the Torpedo."

Mr. W. H. Preece, C.B., last Monday evening delivered a lecture to the Moriah Chapel Literary Society, Carnarvon, on "The Practical Application of Electricity."

The City Company's Mains.—Just as we go to press we have been shown an advance proof of an article which is to appear in the next issue of *To-Day*. It refers to the extract which we quote in our leading columns, and is in effect a frank admission that its comments upon the City Company's mains were completely unfounded. Our contemporary also publishes a letter from Mr. Cooke, the engineer to the City Company, who states that no trouble whatever has ever been experienced with the conductors supplied by the British Insulated Wire Company, now amounting to 107 miles. *To-Day* apologises for its error in the most straightforward manner, and we are glad that there is just time left to us to make the *amende* known to our readers. Mr. Crompton also writes that his four years' experience of these cables has been completely satisfactory.

Coast Communication.—The necessity for further extensions in the connection of lightships with the shore telephonically is evidenced by the case of the man who recently met his death by falling from the lantern of the Tongue lightship. The circumstances are doubtless known to our readers. It is to be lamented that the poor man was compelled, notwithstanding his seriously injured condition, to exist without medical attendance for some hours. The lightship lies off Margate, but as there was a thick fog at the time, the man must have remained unattended medically for much longer, had not a passing steam collier, which was journeying up to London, rendered assistance by conveying him to Blackwall. Life was extinct when the collier arrived at Blackwall. Many people would hardly believe it necessary to come to London for medical assistance when Margate was so near, but such were the circumstances of the case, that no communication whatever could be effected with the contiguous shore. Although there do not arise many accidents such as this, it is to be hoped that the possibility of their occurrence will soon be lessened by the Government granting a large sum of money to complete the humane task which it has commenced.

The Conductivity of Pure Water.—Few chemists probably would ever admit that such a thing as pure water, or pure anything else, has ever been obtained, even by the most careful laboratory operations. With the limited means at our disposal, the most we can ever achieve is an approximation to purity, an approximation doubtless sufficiently close for ordinary humans. Granting this, it is clear that if we are ever to arrive, for example, at a definite value for the electrical conductivity of pure water, it must be by means of mathematical calculation based upon observations with water in as high a state of purity as we can get it, or form it. On these lines F. Kohlrausch and A. Heydweiller have recently been working. The water was distilled and examined in a vacuum, as it had been found previously that contact with air rapidly elevates the conductivity value; this in four minutes rose from 0·11 to 0·14, and in two hours to 0·58. The results at various temperatures of the purest water obtainable were:—

0°	18°	25°	34°	50°
0·014	0·040	0·058	0·089	0·176

The value $\frac{d}{d}\frac{k}{t}$ was calculated at various temperatures, and also the theoretical value as derived from the data of the dissociation theory, and from the result the value $k = 0{\cdot}0361$ was deduced for pure water at 18°, the difference $= 0{\cdot}0043$ being ascribed to the presence of impurities.

Personal.—According to the *Sussex Daily News* it would seem that Sir David Salomons is to be honoured at Tunbridge Wells with the dignity of the mayoralty. As the paper mentioned says, it is very fitting that Sir David should wear the robes during the coming year, as the electric light is to be turned on within that period.

NEW COMPANY REGISTERED.

Medical Electrical Institute, Limited.—Capital, £75,000, divided into 25,000 £7 per cent. preference shares of £1 each, and 20,000 ordinary shares of £2 10s. each. Objects: To purchase or otherwise acquire all the business, goodwill, assets, property, &c., of the Medical Battery Company, Limited, to enter into and carry into effect an agreement dated October 16th, 1894, between the Medical Battery Company, Limited (in liquidation), of the one part, and Herbert Banyard (for this company) of the other part, to provide for and carry out, under the control and superintendence of a duly qualified medical man, the treatment of diseases by means of galvanic, electric, and magnetic appliances, batteries, baths, medical and other apparatus, and by massage, hydrotherapic inhalation, mechanical exercise (Dr. Zanders' and any other system), chemical, dental, and other processes, and to carry on the business of manufacturers of and dealers in all kinds of galvanic, electric, magnetic, mechanico, therapeutic, gymnastic, and other appliances, chemists and druggists, dentists, chiropodists, Turkish and other bath proprietors, &c. Signatories (with one share each):—Alfred Cowen, 12, Charter Buildings, Goswell Road; Thomas S. Smith, 80, Mallinson Road, Battersea Rise; Chas. L. Quin, 64, Basinghall Street, E.C.; Wm. Brittain, 136, Windsor Road, Forest Gate, E.; P. Jerome, 9, Boutflower Road, Wandsworth; F. J. Horrocks, 17, Goldhurst Terrace West, N.W.; Aubrey Lienard, Newport Villa, Muswell Hill. There shall be six first directors; the first are Charles G. Elers and John Oliver (nominated by ordinary shareholders), Arthur L. Poulter and Leopold J. Greenberg (nominated by preference shareholders), and William B. Jones and Augustus Fleet (nominated by second mortgage debenture holders). Qualification, 100 ordinary or 50 preference shares, or £100 second mortgage debentures. Remuneration, £600 per annum, or 5 per cent. of the net divided profits divisible. Registered office, 52, Oxford Street, W. Registered October 16th by Jerome & Co., 38, Basinghall Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electric and Automatic Engineering Company, Limited (37,260).—This company's yearly return shows that, out of a nominal capital of £10,000, in £1 shares, 47 shares have been taken up, and that the full amount has been called on each. A sum of £40 has been received, and £7 is outstanding.

Roger Dawson, Limited (37,901).—This company's yearly return shows that, out of a nominal capital of £15,000, in £1 shares, the whole number of shares have been taken up, and that the full amount has been called and paid on 7 shares. There has been £14,993 agreed to be considered as paid.

Railway Electric Reading Lamp Company, Limited (36,749).—This company's annual return shows that, out of a nominal capital of £100,000, in £5 shares, 7 shares only have been taken up. Nothing has been called or paid.

Telephone Company of Austria, Limited (18,244).—This company has been wound up voluntarily, the liquidators being Messrs. Henry Grëwing, C. L. W. Fitz-Gerald, R. E. Bateman, and J. H. Buckingham.

Ruston, Proctor & Co., Limited (29,346).—This company's yearly return shows that out of a nominal capital of £250,000, in £10 shares, 25,000 shares have been taken up, and that the full amount has been called and paid on 17,500. A sum of £175,000 has been received, and £75,000 has been agreed to be considered as paid.

Woolwich District Electric Light Company, Limited (31,814).—This company's annual return shows that out of a nominal capital of £10,000, in £1 shares, 5,435 shares have been taken up, and that £1 has been called and paid on each of 5,285 shares. A sum of £150 has been agreed to be considered as paid.

Sheffield Electric Light and Power Company, Limited (36,351).—This company's yearly return shows that out of a nominal capital of £98,000, in £7 shares, 8,625 shares have been taken up, and that £1 has been called on each. A sum of £8,625 has been received, and £20,000 has been agreed to be considered as paid.

United River Plate Telephone Company, Limited (23,654).—This company's yearly return shows that out of a nominal capital of £500,000 in £5 shares, 58,000 shares have been taken up, and that the full amount has been called on 42,000. A sum of £210,000 has been received, and £80,000 has been agreed to be considered as paid.

Windsor and Eton Electric Light Company, Limited (27,756).—This company's yearly return shows that out of a nominal capital of £30,000 in 5,950 £5 and 250 £1 shares, 438 £5, and 102 £1 shares, have been taken up, and that the full amount has been called on each. A sum of £2,237 has been received, and £55 is outstanding.

Dixon & Corbett and R. S. Newall & Co., Limited (24,228).—This company has filed its yearly return, which shows that out of a nominal capital of £120,000, in 6,000 ordinary and an equal number of preference shares, all of £10 each, the whole of the ordinary and 1,957 of the preference shares have been taken up. Nothing has been called on the ordinary, and £8 has been called on each of 1,707 preference shares. A sum of £13,648 has been received, £62,500 has been agreed to be considered as paid, and £8 is still outstanding.

Exeter Electric Light Company, Limited (26,059).—The annual return of this company shows that out of a nominal capital of £20,000, in 1,500 ordinary and 500 "A" 6 per cent. preference shares, 1,125 of the former and 73 of the latter have been taken up. The full amount has been called on 820 ordinary and 58 "A" shares, and £1 has been called on each of 15 "A" shares. A sum of £8,795 has been received, £3,050 has been agreed to be considered as paid, and £135 is the amount of capital uncalled.

Ford-Lloyd Manufacturing Company, Limited (38,998).—This company's annual return shows that out of a nominal capital of £10,000, in £1 shares, 4,707 shares have been taken up, and that the full amount has been called and paid on 707 of these. A sum of £4,000 has been agreed to be considered as paid.

Immisch Electric Launch Company, Limited (41,118).—This company's statutory return shows that out of a nominal capital of £12,000, in 10,000 ordinary and 2,000 preference shares, all of £1 each, 8,965 ordinary, and 1,507 preference shares have been taken up, and that 5s. has been called on each of 1,507 of the latter class. A sum of £301 has been received, £8,965 has been agreed to be considered as paid, and £75 15s. is outstanding.

Planet Electrical Engineering Company, Limited (28,557).—This company's yearly return shows that out of a nominal capital of £30,000, in £5 shares, 3,482 ordinary and 160 preference shares have been taken up, and that the full amount has been called on 2,682 ordinary and 160 preference shares. The total received is £14,210, and £4,000 has been agreed to be considered as paid.

South-Western District and Thames Valley Electricity Supply Company, Limited (29,245).—This company's yearly return shows that out of a nominal capital of £100,000, in £10 shares, seven shares only have been taken up and fully paid.

Walsall Electrical Company, Limited (37,696).—This company's yearly return shows that out of a nominal capital of £10,000, in £10 shares, 683 shares have been taken up, and that the full amount has been called and paid on 483 shares (£4,830). There has been £2,000 agreed to be considered as paid.

CITY NOTES.

Venezuela Telephone Company.

The ordinary general meeting of the Venezuela Telephone and Electrical Appliances Company, Limited, was held on Tuesday last at the offices, 37, Lombard Street, E.C.

Sir Douglas Fox presided, and stated that the report the directors presented was unmistakably the most satisfactory one that had been submitted since the initiation of the company. The profit for the year amounted to £7,413, as against £4,143 last year, and the sum actually earned, leaving out of the question balances, was £2,753, which showed that they were now established on a firm basis, and were able to make a fair return not only to the debenture-holders, but to the shareholders. Since the present manager (Mr. Wallis) was appointed there had been a considerable reduction in the operating expenses on the other side of the water, while the business had increased from £18,444 last year to £21,284 this year. He believed that, owing to the efforts Mr. Wallis was making, they might fairly hope for a further reduction in the operating expenses. At present they stood at 56 per cent., as against 60 per cent. last year. Their capital, which amounted to £152,900, exactly represented the sum which had been expended—that was to say, cost of the property, stores, and material at Caracas. He attributed the present satisfactory financial position of the company to the business-like arrangements made by Mr. Phillips when he visited the property recently. He concluded by moving the adoption of the report and accounts.

Mr. J. W. Philips seconded the motion.

Mr. E. A. Wallis (the manager) stated that during the year the subscribers had increased in Caracas by 195, in La Guaira by 7, in Valencia by 21, and in Puerto Cabello by 16, making a total increase of 239 subscribers over the year 1893.

The motion was agreed to.

After the re-election of the retiring director and auditors, a vote of thanks was given to the chairman and board.

The Eastern Extension, Australasia, and China Telegraph Company, Limited.

The directors' report states that the gross receipts, including Government subsidies, have amounted during that period to £247,681 2s. 4d., against £257,986 13s. 5d. for the corresponding half-year of 1893. The working expenses, including £21,295 16s. 5d. for cost of repairs to cables and expenses of ships, absorb £80,295 3s. 10d., against £78,229 19s. 3d. for the corresponding period of 1893, leaving a balance of £167,385 18s. 6d. From this is deducted £3,940 2s. 7d. for income tax, £32,488 13s. 9d. for interest on debentures, debenture stock, contribution to sinking fund, and re-valuation of currency balances, leaving £130,957 2s. 2d. as the net profit for the half-year. Two quarterly interim dividends of 1¼ per cent. each, amounting to £62,500, have been paid for the half-year under review, leaving £68,457 2s. 2d. to be carried forward. The loss resulting from the third year of working, ended April 30th last, under the Australian tariff guarantee arrangement, amounted to £12,384, half of which was borne by the guaranteeing Governments and the other half by the associated cable companies in terms of the agreement. The laying of the company's alternative cable between Singapore and Hong Kong *vid* Labuan was successfully completed by the Telegraph Construction and Maintenance Company, and the line opened for traffic on May 5th last. It has already been found a most valuable addition to the company's system. A short length of cable has also been laid between Labuan and Borneo, so as to give direct telegraphic communication with Sandakan, the headquarters of the British North Borneo Company, when the land line, which is in course of construction by that company across North Borneo is completed. Numerous cable repairs have been carried out during the half-year under review, but owing to the system being duplicated, the traffic has not been affected.

The Brazilian Submarine Telegraph Company.

At the general meeting of this company, held on Wednesday, Sir John Pender, after dealing with the accounts, which he considered on the whole satisfactory, passed on to speak of the general position of the company. Notwithstanding the decrease in some of the figures, they were still keeping up their dividend, and increasing their reserve fund. The company's lines had carried 40,000 more words during the past half-year than in the previous one. News telegrams had increased, and the company was desirous of fostering this traffic. They had, as would be seen from the balance-sheet, £40,000 in the Azores Company. He was not in a position to make any definite remark on this, but he would say that the Eastern Company had secured a concession from the German Government which would not only give them special advantages in obtaining and carrying the German traffic, but also provided them with a subsidy. The Brazilian Government having held that the company's privileges had expired in 1892, had imposed a tax on their traffic. The company held that their concession had not expired, and had sent out an agent to assist at a friendly arrangement. The visit was made at a time of civil disturbance, and their agent would be sent out in the hope of coming to some understanding with the Brazilian Government. The Western Brazilian Company were equally affected in the matter, and he held that their common interests might be better safeguarded if there could be a closer alliance between these two companies. He hoped that the time was not far distant when this question would be fairly considered by both bodies of shareholders.

Mr. Brodrick, M.P., seconded the motion for the adoption of the report and the declaration of a dividend.

The motion having been agreed to, Sir J. Pender and Mr. Brodrick were re-elected directors, and the proceedings closed with a vote of thanks to the chairman.

The Monte Video Telephone Company, Limited.

The directors' report, to be presented to the shareholders at the annual general meeting, to be held at No. 96, Gresham House, Old Broad Street, E.C., at 12 o'clock noon, on October 31st, 1894, states that the accounts, duly audited for the year ending July 31st last, show a net profit of £6,902 15s. 11d. After making provision for all working expenses in Monte Video and London, depreciation of stock of materials in Monte Video, and writing off the final amount of preliminary expenses, there remains an available balance, including the amount of £775 2s. 9d. brought forward from last year, of £7,677 18s. 8d. It is with satisfaction that attention is drawn to the result of the year's working of the company's business. The amount of subscriptions shows an increase compared with last year of £460, while the capital expenditure during the year was £875 6s. 3d., as against £1,637 4s. for the previous year. The entire property has been maintained in efficient repair at the cost of revenue. After careful consideration of the whole position of the company, the directors recommend the payment of a dividend of 4 per cent. on the preference share capital, absorbing £5,600, which, after placing £1,000 to reserve account and £500 to reserve for bad and doubtful debts, leaves the sum of £577 18s. 8d. to be carried forward to next year. It will be observed that the position of the company is improving, and keeping pace with the general prosperity evidenced in industrial and financial circles throughout Uruguay. In accordance with the articles of association, Mr. Herbert Ward retires from the board, and being eligible, offers himself for re-election. The auditors, Messrs. Gérard Van de Linde & Son, also retire, and offer themselves for re-election.

Westminster Electric Supply Corporation, Limited.

An extraordinary meeting of the shareholders was held at the Eccleston Place offices on Wednesday morning, Lord Suffield presiding. The purpose of the meeting was to pass a resolution increasing the capital of the corporation from £300,000 to £400,000.

The Chairman, in moving the resolution, said he would take the opportunity of saying that the prospects of the corporation were very brilliant. They had passed through a great deal of difficulty; that statement was apparent to everybody. The directors did not propose to apply any portion of the new capital towards extra buildings. They are not at all requisite, nor do the directors apprehend they will be required for a very long time to come—perhaps never—but owing to the very considerable increase of business, it was necessary to have more plant, meters, mains, and various other expenses were to be met. It was not proposed to issue the whole of the capital now, nor a large part of it at once, but it would be issued when absolutely required. Regarding the increase in the business, the chairman stated that on December 31st, 1893, the lamps on circuit were 131,565 8-C.P., and now they had reached 158,000 lamps, about 9,000 more were waiting to come on, and applications were still being received at the same rate. In the new issue the existing shareholders are to have first opportunity. He moved the increase of the capital from £300,000 to £400,000.

Mr. E. Boulnois, M.P., seconded the motion, which was carried.

In reply to the questions of shareholders, the Chairman said they did not intend increasing their present area, and the terms of the issue would be determined before the confirmatory meeting to be held in about a fortnight. He also referred to the desirability of building up a reserve fund, and any premiums on the new shares would probably be placed to that.

A number of shareholders thought the shares should be offered to them at par.

Eastern and South African Telegraph Company, Limited.—It is notified that on Monday, November 19th, at noon, at Winchester House, 362 5 per cent. mortgage debentures will be drawn for payment on January 1st. The payment by warrants on November 1st of interest on the 4 per cent. Mauritius subsidy debentures is also announced. The transfer books will be closed from October 27th to November 1st inclusive.

The Indo-European Telegraph Company, Limited.—The directors have declared an interim dividend for the half-year ended June 30th last, at the rate of 5 per cent. per annum, free of income tax, payable on and after the 1st prox.

Stock Exchange Notices.—Application has been made to the Stock Exchange Committee to allow the following securities to be quoted in the Official List:—City and South London Railway Company—Further issue of £39,000 4 per cent. perpetual debenture stock, and 650 5 per cent. perpetual preference shares, Nos. 7,001 to 7,650.

Eastern Telegraph Company, Limited.—The payment by warrants on November 1st of interest for the half-year ending October 31st, on the 4 per cent. mortgage debenture stock, is notified. The transfer books will be closed from October 27th to November 1st, both days inclusive.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 21st, 1894, amounted to £932; week ending October 22nd, 1893, £810; increase, £122; total receipts for half-year, 1894, £13,863; corresponding period, 1893, £12,956; increase, £907.

The Liverpool Overhead Railway Company. The traffic receipts for the week ending October 21st, 1894, amounted to £888; corresponding week last year, £611.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 19th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited, were £3,215.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation October 17th.	Closing Quotation, October 24th.	Business done during week ended October 24th 1894. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	...	...	...	102 —105	102 —105	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 12s.	£2 15s.	£2 11s.	38 — 41 xd	38 — 41	38	...
2,993,560£	Do. do. 6 % Pref.	Stock	£5 5s	£5 10s	£5 2s.	75 — 76 xd	74½— 75½	75¼	74⅝
2,993,560£	Do. do. Defd.	Stock	...	...	...	6⅜— 7¼	6⅜— 7¼	...	...
130,000	Brazilian Submarine Teleg., Ltd.	10	8 % §	6½% §	6½% §	12¾— 13¼	12¾— 13¼	13¼	12⅞
75,000£	Do. do. 5 %, repayable June 1906	100	...	...	...	110 —114	110 —114	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 40,000	5	... §	10%‖ §	... §	2 — 3	2 — 3	2 5/16	2¼
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	135 —145	135 —145	142	...
224,850	Consolidated Telep. Const. and Main., Ltd. ...	10/-	3½% §	2 % §	2 % §	⅛— ¼	⅛ — ¼	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12½— 13⅛	12½— 13½	13	12⅝
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Teleg., Ltd., £4 paid	5	4½%	4 %	4 %	4¼— 4⅜	4¼— 4⅜	...	...
6,000	Do. do. 10 % Pref.	5	10 %	10 %	10 %	9¼— 9⅜	9¼— 9⅜	9⅜	...
30,000£	Do. do. 4½ % Debs of £50, Nos. 1 to 1,600	...	...	...	...	105 —108%	105 —108%	...	...
60,710	Direct United States Cable, Ltd., 1877	20	3½% §	3½% §	2⅝% §	8½— 9 xd	8½— 9	8⅞	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½% §	6½% §	15⅝— 16 xd	15⅝— 16	16	15⅝
70,000	Do. 6 % Pref.	10	6 % §	6 % §	6 % §	16⅜— 17¼xd	16⅜— 17¼	16⅞	16⅜
102,100£	Do. 5 % Debs., repay. August, 1899	100	..	...	...	106 —110	106 —110	...	...
1,297,837£	Do. 4 % Mort. Deb.	Stock	...	...	...	118 —121	118 —121	119	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	16 — 16¼xd	16 — 16¼	16 3/16	16 1/16
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	...	...	...	103 —106	103 —106	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	...	...	...	103 —106	103 —106	...	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	116 —120	116 —120	...	...
95,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	...	...	...	103 —106	103 —106	...	...
129,100£	Do. do. do. to bearer, 2,344 to 5,500	...	...	...	...	103 —106	103 —106	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 2,016, red. 1909	100	...	...	...	104 —107	104 —107	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	...	...	...	109 —112%	109 —112%	111	...
180,227	Globe Telegraph and Trust, Ltd.	10	5¼% §	4½% §	4⅝% §	8¾— 9 xd	8⅞— 9⅛	9	8⅞
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	6 % §	15½— 16 xd	15⅝— 16¼	16 1/16	15¼
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜% §	8⅜% §	8⅜% §	20½— 21½	20½— 21½	21⅛	20 15/16
190,000£	Do. do. do. 5 % Debs.	100	...	...	...	104 —107	105 —108	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	46 — 48	46 — 48	47½	...
37,548	London Platino-Brazilian Teleg., Ltd.	10	...	...	...	5 — 7	5 — 7	...	...
100,000£	Do. do. 6 % Debs.	100	...	...	...	107 —110	107 —110	...	...
15,000	Monte Video Teleph. Co., Ord., 1 to 15,000	5	...	...	...	¼— ⅜	¼— ⅜	...	...
28,000	Do. do. 6 % Pref., 1 to 28,000	5	...	...	...	1 — 1½	1 — 2	...	...
484,597	National Teleph., Ltd., 1 to 438,984	5	6 % §	5 % §	5 % §	4⅞— 5⅛	4⅞— 5⅛	5 1/16	5
15,000	Do. 6 % Cum. 1st Pref.	10	...	...	...	15 — 15½	15 — 16	15⅛	15¼
15,000	Do. 6 % Cum. 2nd Pref.	10	...	...	...	14 — 15	14 — 15	14⅜	14⅜
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 90,950	5	...	...	...	5½— 5⅝	5½— 5⅝	5⅝	...
1,000,000£	Do. 4½ % Deb. Stock Prov. Certs. ...	...	...	...	...	110 —113	110 —113	...	...
48,800	New Teleph., Ltd., 25,901 to 74,700; £4 paid	10	...	...	...	... ...	... ...	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	...	7/16 — 9/16	7/16 — 9/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	...	...	...	104 —107	104 —107	...	...
11,839	Reuter's Ltd.	8	5 %	5 %	0 %	3 — 5	3 — 5	...	...
3,381	Submarine Cables Trust	Cert	...	...	...	105 —110	105 —110	107	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	2 — 3	2 — 3	2 7/16	2¼
146,733£	Do. do. 5 % Debs.	Stock	...	...	...	88 — 94	88 — 94	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	4 %	..	0 %	3 — 5	3 — 5	...	...
249,900£	Do. do. do. 5 % Debs.	100	...	...	...	100 —103	100 —103	101	...
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	2 — 3	1½— 2½	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	...	...	...	101 —106	101 —106	...	...
64,242	Western and Brazilian Teleg., Ltd.	15	4 %	2½%	2½%	8½— 9	8½— 9	8 3/16	8½
33,129	Do. do. do. 5 % Cum. Pref. ...	7½	...	...	...	6½— 7	6½— 7	6¾	...
33,129	Do. do. do. 5 % Def.	7½	3 %	...	...	2¾— 3¼	2¾— 3¼	2¾	...
171,900£	Do. do. do. 6 % Debs. "A," 1910 ...	100	...	...	...	106 —109	106 —109	...	...
214,800£	Do. 6 % Mort. Debs., series "B," red. Feb. 1910	100	...	...	...	106 —109	106 —109	...	...
88,321	West India and Panama Teleg., Ltd.	10	¼%	¼%	⅜%	1⅜— 1⅝	1¼— 1½	1 5/16	...
34,563	Do. do. do. 6 % 1st Pref. ...	10	...	...	...	10⅜— 11½	10⅜— 11½	11¼	11
4,669	Do. do. do. 6 % 2nd Pref. ...	10	...	...	..	9 — 10	9 — 10	...	...
80,000£	Do. do. 5 % Debs. (1917) No. 1 to 1,000	100	...	...	...	108 —111	108 —111	...	...
$1,211,000	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	...	...	...	115 —120	115 —120	...	...
166,900£	Do. do. 6 % Ster. Bonds.	100	...	...	...	102 —104	102 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply, 1 to 6, 215 to 718, and 10,001 to 30,000	5	...	5 %	4½%	4 — 5	4½— 5⅛	4⅞	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	...	13½— 14½	13 — 14	13⅝	13⅜
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	...	6 %	6 %	14⅜— 15¼	14½— 15	15 1/16	14⅜
100,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	131 —133	131 —133	...	...
56,000	†Liverpool Electric Supply, all paid	5	4½%	5 %	5 %	6⅜— 7	6 1/16— 6 5/16	...	...
49,900	•Metropolitan Electric Supply, Ltd., 6,101 to 50,000 ...	10	1 %	2 %	2½%	9½— 10	9¼— 9⅜	9⅜	9½
100,000£	Do. 5% Deb., 1 to 10,000 in bonds of £10, £20, £40	...	...	...	...	... — ...	... — ...	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	...	5½— 6½	5½— 6½	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-18,780	5	8½%	7½%	4½%	7¼— 7⅜	7½— 8	7⅝	7½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9	8⅜— 9¼	8⅜	...
59,900	•Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	...	3½%	4 %	6½— 7	6½— 7	6 1/16	...

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation, Oct. 17th.	Closing Quotation, Oct. 24th.	Business done during week ended Oct. 24th, 1894. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	...	6 % §	6 % §	2⅝— 2⅞xd	2½— 2¾	2 13/16	2⅝
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	...	6 % §	6 % §	2½— 2¾xd	2½— 2¾	2 15/16	...
125,000*l*	Do. do. 4½ % Deb.	Stock	...	...	...	111 —114	111 —114	...	...
630,000*l*	City and South London Railway	Stock	...	⅝%	⅝%	36 — 38	36 — 38	37¼	...
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 % §	7 % §	7 % §	2 — 2½	2 — 2½	...	...
50,000*l*	Do. do. 5 % 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	...	...	...	94 — 99	94 — 99	...	...
120,000	Electric Construction, Ltd., 1 to 120,000	2	...	...	...	¼— ½	¼— ½	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	...	...	...	1½— 2	1½— 2	...	...
100,000	Elmore's French Patent Cop. Deposg., Ltd., 1 to 66,750 ...	2	*nil*	*nil*	*nil*	3/16— 5/16	3/16— 5/16	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil* ¶	*nil*	*nil*	1⅛— 1⅜	1⅛— 1⅜	1⅜	1 7/16
67,385	Elmore's Wire Mfg., Ltd., 1 to 67,385, issued at 1 pm. ...	2	*nil*	*nil*	*nil*	1½— 1⅝	1½— 1⅝	1⅝	1½
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	*nil* §	½— 1½	½— 1½	...	...
9,600*l*	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	...	...	6½— 7½	6½— 7½	...	...
6,837	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	5 %	8 — 9	8 — 9	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	12½%	24½— 25½	24½— 25½	25¼	24¾
200,000	Do. do. do. 4½ % Deb., 1896	100	...	...	...	102 —104	102 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	...	1 %	7 15/16— 8 1/16	7 15/16— 8 1/16	...	...
6,295	† Do. do. Pref., £8 paid	10	...	...	...	13 — 13¼	13 — 13¼	...	...
	Swan United Electric Light, Ltd.	...	11 % §	10 % §	7½% §	... — ...	... — ...	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	20 %	41 — 43	41 — 43	42⅛	41¾
150,000*l*	Do. do. do. 5 % Bonds, red. 1894	100	...	...	...	106 —109	106 —109	108	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £2 paid ...	10	...	...	...	2 — 2¼	2 — 2¼	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%§; 1891—7%§; 1890—8%§.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¼—5⅜.
Electric Construction Corporation, 6 % Debentures, 87—92.
Electric and General Investment, shares of £5 (£1 paid), 1⅜—2¼.
House-to-House Company (£5 paid), 1—1½.
Do. do. 7 % Preference, of £5, 5½—5⅝.
Do. do. 6 % Debentures of £100, 101—103.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 4⅜—5¼; 1st Preference Cumulative 6 %, £5 (fully paid), 6½—6⅝.
Liverpool Electric Supply, £5 (fully paid), 6⅜—6½.
London Electric Supply Corporation, £5 Ordinary, ⅞—1⅛.
Queen Anne's Mansions Lighting and Heating Company, 6 % £100 Debentures, 101—103.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares (£4 10s. paid), 4½—4⅝.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

ADDRESS BY THE PRESIDENT,

Prof. W. J. Herdman, of Ann Arbor University, Michigan.

The author took for his subject "The Functions of the Association," and commenced by declaring that the formation of the Association four years ago was but "the natural crystallisation from a medium that was already saturated with thoughts, facts, and efforts, having a relationship to electro-therapeutics, but without form, and void" until then.

"The chemist and the physicist have discovered, little by little, how important a factor it (electricity) is in producing the phenomena which occupy their attention. While those who busy themselves with the phenomena of life, the biologist, the botanist, and the physiologist, are continually forced to recognise how indispensable is the presence of electricity in the building up and breaking down of vegetable and animal tissues, and in the conduct of all vital processes. The physician also, who in his best estate must be a combination of all these specialists, and more, long before any of them, observed that electric force was in many ways intimately related to animal organisation, and could be made to influence and modify its functions at will."

After referring briefly to the famous historical researches, and pointing out that the physicist and the physiologist, the biologist and the physician, had, for the most part, pursued their ways independently, Prof. Herdman continued: "But each has found that he has been dealing with a force or energy whose activities extend far beyond the limits of his narrow field, and eagerness to know more has tempted one and another to overstep the boundaries of his own domain, to learn what his neighbour has discovered, and to get at some hint that may expand his vision, and lead to larger concepts of the truth."

It followed, therefore, that the physician could no longer hold aloof from any who could bring testimony of value concerning the nature of the agent he employed. Thus was the American Electro-Therapeutic Association conceived and organised.

In referring more particularly to the functions of the Association, the President declared that primarily it has a duty to perform in the improvement of electrical nomenclature and terminology. "Words must mean the same to the electro-therapist as they do to the physicist. For the sake of simplicity, clearness of thought, and in the interests of progress, the electro-therapist must be willing to lay aside his 'galvanism' and 'faradism,' and speak of 'constant' and 'induced' currents, while the physicist, the electric engineer, and the biologist, on the other hand, must avoid the extremes of peculiarly technical expression while discussing questions in a congress of this character, that have a wider scope than the limits of any one specialty."

Another important "function" was given as "the opportunity for the worker in pure science and the technologist to meet and compare results." On this head Prof. Herdman remarked that "Our membership is already strong in the department of electro-physics, the groundwork of the science we are attempting to build up," but that "We are much in need of the investigations of biologists and physiologists."

Next, the duty of promoting accurate measurement, and in assisting to fix a uniform standard of measurement of electric stimuli as used in physiology and therapeutics, was pointed out.

Lastly, the educational aspect of the Association, and the opportunities it offered for bringing into prominence the need for systematic electro-therapeutic instruction in the medical schools, was dwelt upon at some length. "With the solid work done by this, and kindred associations, massed before it, and the light infantry methods for disseminating information to the laity on either flank, the Medical College curriculum will be compelled to surrender to the demands of electro-therapeutics."

The concluding words were as follows: "It would certainly appear from this brief sketch of what I conceive to be a few of the functions of this Association, that it was not born without a purpose. It has so far given evidence that it is fully conscious of the weighty responsibilities that have devolved upon it, and has laid its foundations broad and deep in its efforts to fulfil its mission, and construct the edifice that will serve as a storehouse in this department of science so intimately related to human welfare."

REPORT ON SECONDARY BATTERIES.

By R. G. Brown, E.E.

On February 1st a personal letter, enclosing a copy of the circular issued by the Association, was sent to manufacturers and dealers in storage batteries, calling their attention to this subject as outlined on page 5 of the circular. The letter was virtually an invitation to send in a sample battery for examination and test, and included such information and data as was thought would be of assistance to the party addressed in arranging a suitable outfit. This letter was sent to twenty-one persons.

The replies received in answer to this letter indicated an earnest desire on their part to accept this proposition, and it was confidently thought at one time that at least a dozen outfits would be sent in; but in spite of a brisk correspondence, and extending the date set for the commencement of the test well into April, only four batteries arrived, namely:—Franklin Electric Company, Passaic, N.J.; E. B.

Meyrowitz, New York; Electric Storage Battery Company, Philadelphia, Pa.; Otto Flemming, Philadelphia, Pa.

Description of the Outfits.—The Franklin Electric Company's battery is of the Planté type. The plates consist of a frame filled with alternated straight and corrugated strips of lead; no pastes or applied oxides are used, the active material being formed entirely of, and on, the plate itself. The formation of the peroxide on the corrugated strips cause them to expand, and thus folding on themselves, lock the peroxide firmly into place. The plates are separated by sticks or hard rubber, and the whole held together by bolts of hard rubber passing through the corners of the frames. The outfit submitted consists of two cells, each having a working E.M.F. of 2 volts, and a capacity of 50 ampère hours. There is a sliding rheostat arrangement for controlling the current.

Like most dealers in physicians' supplies, Mr. Meyrowitz is not the actual manufacturer of the cells furnished in his outfits, but supplies those made by the American Battery Company, of Chicago, Ill., type T1, consisting of five plates, two positive and three negative. The plate is made up of a series of horizontal strips of rolled lead, grooved on both sides and half an inch in width. These strips are arranged in a frame made of a special composition not affected by acids, and the plate is then ready to be "formed." The plate is then submitted to the forming process which oxidises the surface of the lead strips until the spaces between them are completely filled with the oxide; thus the plate is made up of alternate layers of lead and active material, the grooved surface of the lead effectually keeping the active material into place. The plates are separated by hard rubber combs, and the whole bound together with soft rubber bands. The outfit consists of two of these cells, each with a capacity of 40 ampère hours, and an E.M.F. of 2 volts. It includes a current controlling device, and a switch for throwing one or both cells into circuit.

The outfit of the Electric Storage Battery Company, manufacturers of the chloride accumulator, is as follows:—Chloride of lead and zinc are fused together in certain proportions, and poured into moulds. The plates so cast, of which we have here a sample, will form the active material later. They are a quarter of an inch in thickness, and have grooves running horizontally and vertically on each side, and at each point where the grooves intersect there is a perforation. The plate is then placed in a larger mould, into which is poured a molten alloy of lead and antimony. In this manner a strong frame is formed around the squares of the active material on both sides of the plate, and the two frames are joined together by the union of the alloy through the perforations. The forming process consists in placing these plates alternately with plates of pure zinc in a trough containing a solution of dilute chloride of zinc, thus forming a simple primary battery, and the cells are short-circuited in groups. By this operation the chloride of lead is reduced to a pure metallic lead, and the zinc is dissolved from the surface of the plate, leaving it soft, porous and spongy, thus producing a plate having a remarkably large surface of active material as compared to its weight. This company's outfit consists of two 5-plate cells, each cell with a capacity of 50 ampère-hours and an E.M.F. of 2 volts. The normal rate of charge and of discharge is 5 ampères, but the battery is fully capable of being discharged at as high a rate as 20 ampères without injury. There is a switch for throwing the two cells in series or multiple, and a current controller. The three small binding posts on top are for the purpose of attaching a 2-volt lamp to be used to test the condition of each cell. The open circuit voltage of a cell is a poor indication of its exact condition, but with a 2-volt lamp one can tell very closely by the brilliancy of the light the real condition of the cell.

Mr. Flemming does not manufacture the plates in his batteries, but employs those of the chloride accumulator just described. He makes a speciality of providing an assortment of outfits to suit the various requirements of medical surgery. They range from one to twenty cells. The outfit submitted consists of three five-plate cells, which are permanently connected in series, and have a total E.M.F. of 6 volts, with a capacity of 22 ampère hours. There is an ingenious rheostat arrangement for controlling both cautery and lamp; it is divided to a very fine degree, takes up very little room, and, with excessive discharge, there is no heating of the parts. This particular outfit is intended to be essentially a portable one, and used for the lighting of small lamps and light cautery work. Its weight is 23 lbs.; it will keep an endescope lamp burning 27 hours, or a cautery knife two hours, and is sold at $30.00.

During the test, which was carried on through May, June, July and August, the readings were made with Weston standard meters, kindly loaned by the Weston Electric Installation Company, of Newark, N.J., for this test. The cells were frequently short circuited for a few moments at a time, and when ever occasion offered, were used in actual operations.

In conclusion, the several outfits sent in have done all that was claimed for them. The cells themselves are well and favourably known in the electrical industries for their efficiency, and are very extensively employed in electric lighting, launch, and traction work. If properly looked after, there is no reason why either of these outfits should not serve a physician faithfully for at least a term of five years.

ELECTRO-PHYSIOLOGY.

By A. E. Dolbear.

In the early days of electrical applications to therapeutics no one knew what to expect. At best it was thought that electricity was a very mysterious something with limitless possibilities; but unless the patient could feel its effects, it was thought nothing happened. Again, it was held that electricity was electricity, and induction coil discharges which could be felt were proper for all sorts of diseases when it could be applied. As there were no units, no one knew what nor how much he was giving or taking.

The cautious physician very properly would not venture to employ an agent he knew little or nothing about, while the quack, with his mysterious machine and wise look, often succeeded in inspiring his patients with confidence in himself, and a high degree of expectancy which, as every physician knows, are of high therapeutic value for the larger number of ailments he is called upon to treat. He therefore sometimes surprised himself and others by his success where they had failed, and electricity got all the glory for success, while the failures were never counted.

Now that one may know exactly the nature of the current he uses, as well as its quantity, the successful application to physiological purposes has begun in an intelligent way.

At the outset one has to make the enquiry whether electrical action in the body and out of it are or are not radically different. Are there physiological conditions which dominate, or is electricity in the body, as well as out of it, subject only to its own laws?

The physiologists and biologists have quite given up what was called "vital force," and stoutly maintain that in the last analysis all physiological processes are physical and chemical. If that be granted, then one may start with the assumption that the only difference in the action of electricity in a living body and out of it are differences in the degrees of complication. I believe that it is conceded among physicians who have studied the physiological effects of electricity that the immediate effects are altogether physical and chemical.

Assuming this to be true, one may enquire what are the physical and chemical effects of electricity, in order that he may look for them in physiological processes.

1. A current of electricity always heats the conductor through which it goes, and this quite independent of how much work of other sorts may be done in the same circuit. Whether it be turning a motor or lighting an arc or incandescent lamp, or decomposing a chemical compound or any other, these simply cut down the current in their circuit, and the heating power is proportional to the square of the current. So one may conclude that when an electrical current is sent through any part of the body, that part is more or less heated. With such currents as are employed in everything except perhaps in electrocution, the heating effect is so small as to be well nigh ignorable. A current of 1 ampère in a resistance of 1 ohm will raise the temperature of a pound of water only one-hundredth of a degree in a second, but the resistance of the body is to be reckoned by thousands of ohms, and the currents employed in thousandths of an ampère. A current of 10 ma., or the hundredth of an ampère through 1 ohm, would heat it only one ten-thousandth of one hundredth or the millionth of a degree in a second, or, to state it in another way, would require nearly two weeks to heat a pound of water one degree.

2. A current will produce light, as is evidenced in the arc and incandescent lamps, but the light is the effect of the high temperature, for it is the carbon raised to incandescence which is the cause of the light, and as the heating effects are so minute, no luminous results due to incandescence can be expected in physiological applications. There is another kind of luminousness observed in rarefied gases when alternating currents of high voltage are sent through them, but they are not observable in solids and liquids, and there is no evidence that there is any corresponding physiological effect.

3. A current may bring about chemical decomposition. A typical case of this is the decomposition of water. To effect this an electromotive force of as much as 1½ volts is necessary, as the electromotive pressure of water composition is 1½ volts. When a single cell, such as any of the ammonium chloride cells, is employed directly for physiological purposes, water decomposition cannot be expected; but where the same cell is used with an induction coil, the voltage which comes from the secondary cell, with hundreds or thousands of turns, may be reckoned by the hundred. In this case water would be freely decomposed at both electrodes, both oxygen and hydrogen being set free. If there were no other substance than water present, these elements would at once be recombined, so that no collection of gas would be observable; nevertheless there is every reason to believe that even here the same hydrogen and oxygen would not be combined into a given molecule, but the decomposed molecules would have changed positions. In the presence of other substances than water there is every reason to expect other combinations at both poles, and what the product would be would depend upon what substances were present at the places, also their looseness of chemical combination. The substances of the electrodes themselves might be attacked, as for instance, copper or silver might be slightly oxidised, and hydrogen freed or not, depending upon the quality and conditions of the adjacent molecules. The point here is that one must not assume that chemical decomposition of water does not take place because he can detect no evidence of free oxygen or hydrogen. Whenever a current can enter the body it enters through its fluid conductors, chiefly water, dried tissues of all sorts being non-conductors.

4. An electric current will make a magnet, or rather it is a magnet itself. The current in a conductor of any kind endows the substance of the conductor for the time, with all the qualities of magnetism. It possesses a so-called magnetic field with ether tension concentric with it, and a magnetic needle tends to set itself at right angles to it, and this is as true for the body, or part of the body, through which a current goes, as it is true for a piece of copper or iron wire. If the current be a continuous one such as one gets from a battery, the needle will indicate it by swerving from the meridian. If it be an interrupted or alternating current the needle may show no sign of movement, because it takes time for it to move, and if it be solicited to move in one direction, and before it has had time to turn it be solicited to move in the opposite direction, it will stand apparently still, but it would be wrong to infer that the needle was unaffected. With such small currents as are used for physiological purposes, such

magnetic effects would only be observed by working with delicate needles.

The magnetic field, whatever its source, reacts in some degree upon all kinds of matter within it. Upon what we call magnetic substances, such as iron, nickel, and cobalt, it acts to set them in positions in its own lines. All other substances are set in positions at right angles to these. These phenomena are known as para-magnetic and dia-magnetic phenomena. Excepting iron and nickel, these effects are weak with ordinary currents and at ordinary temperatures, but they are exalted at low temperatures. What I would emphasise is that in a magnetic field all kinds of molecules are acted upon by a pressure tending to twist them into new positions, and this must be true in the body of a living thing as it is for things external to it. If on account of opposite pressures a given body does not move at all, then is it subject to what in mechanics is called a strain. Its form has been more or less distorted. As I am not now concerned with amounts of distortion or changes in position, it does not matter whether the actual quantity be of one value or another. By coiling a wire through which an electric current flows, the magnetic field of a greater length is concentrated at the place, and the effects are correspondingly increased, but they differ only in degree from that shown by any part of the circuit. With a constant current from any source to provide a magnetic field, with or without coiling the conductor, or with a permanent magnet of any form, the field is a constant stress and acts upon all bodies in it in some degree. As doubtless you are all aware, there have been many attempts to discover this field by sensation. Lord Kelvin tried it years ago, and expressed some surprise that there did not appear to be a magnetic sense.

Peterson and Kennelly have more recently tried it with exceedingly strong fields, and they have concluded that "the human organism is in no wise appreciably affected by the most powerful magnets known to science."

As to such conclusions, I would suggest that the explanation of the failures to perceive any effects might be attributable to two causes:—1. A magnetic field acts upon *molecules*, not upon physiological organs as such. There is no tendency to twist, warp, or strain a muscle as such, and hence sensory nerves for muscular movement would have nothing to report. 2. A constant stress of light value does not give rise to sensation for ordinary mechanical causes. Lay the arm carelessly, and without looking at it, on the table where it can be comfortable, and for a short time turn the attention to other matters. Then without looking at the arm, or moving it in any way, see if you can tell how the fingers are crooked, or which ones touch the surface of the table. Not until some muscles be moved can one tell what shape his hand is in, and yet it has been subject to constant pressure all the time. For this reason, then, a constant pressure producing no movement ought not to be expected to give a perception. I am not surprised at the results reached. 3. A magnetic field, whether constant or varied, has no chemical effect. It does not bring about atomic changes. Such changes require energy of a different sort, and any nerves whose function it was to respond to chemical changes would not find anything to report from a magnetic field.

As for the brain itself, which has been exposed to the strongest available magnetic field for considerable lengths of time with no results noted, I would ask why one should expect sensation from an organ which is itself not sensitive? Cannot the brain itself be dipped out with a spoon without sensation? Sensation implies nerves, and particular sensations particular nerves, and there are no substitutions. If the brain were affected by a magnetic field, I should expect it would need to be detected by other means than by the direct sensation. I therefore conclude that the experiments alluded to prove that magnetic effects do not produce the mechanical and chemical changes necessary for sensation, rather than they are absolutely without any effect. This latter conclusion, if adopted, would at once demand the acceptance of the proposition that electrical effects are not the same within the body as they are without, and that would necessitate in physiology the revival of a vital force, or something like it.

5. An electric current in a given conductor induces another electric current in an adjacent conductor. It does this by virtue of the magnetic field which it forms about itself, and a moving magnetic field, however originated, acts in the same way to set up an electric current in neighbouring conductors. The so-called induced current lasts no longer than the magnetism is changing the strength, and quite stops when the field no longer changes, no matter how strong the latter may be. Hence it is possible to set up electric currents in any conducting body without having any electrical conductor between it and a primary source of electricity. This is the principle employed in telegraphing without wires between the points. Whether such a method has any physiological importance I do not know, but I should think it might sometimes where currents of particular frequencies or character are desirable, and not so easily to be had with an electro-magnetic breaker as in the ordinary induction coil. In another way it has some theoretic interest. It has been reported that anesthesia may be brought about by subjecting a part of the body, a finger, for instance, to an alternating magnetic field. This, observe, is not sensation, but the absence of it; there is nothing in the reports of the experiments with magnetic fields to indicate that tests of sensativity were tried; they were probably not tried in any.

Now, I believe it has been demonstrated that alternating electrical currents at some unsettled, but very high rate of alternations can, for the time being, destroy sensation, so that, say, a tooth may be pulled without pain. If there be nerves of sensation in an alternating magnetic field, and they be made a part of an electric circuit as they very well may be made, then changes of magnetic polarity may bring about *current* changes in the organism, and these may have any of the results that belong to currents, and if currents under any conditions will produce insensibility, then the effects between magnetic poles will be due, not to the magnetism itself, but to the currents of electricity which the magnetism induces.

I have heard it objected to the view that magnetic fields could produce any physiological effects, that, if so, those who work with alternating currents of electricity, and especially such as are near dynamos and transformers, would have noticed it, yet none have ever reported it. If, however, the real effect was one to lessen their sensativity in general, one would hardly expect to know anything about what happened without comparison. This would need to be for all the nerves. Can one see, or hear, or taste, or smell, or touch, as acutely in such a varying magnetic field, or with alternating currents, as he can without them?

If there is anything at all in this anesthesia by currents without bringing on tetanus, I should suppose it would have a wonderful field. For instance, in sea sickness there would be found a current of some degree and frequency that would be quite insensible to the feelings, which would prevent at once the nervous condition, and an electrical device could be worn continuously on shipboard without, discommoding one. The chief difficulty, I should suppose, would be to find the proper route for the provided current. If, for instance the immediate cause of sea sickness be, as I have somewhere read, the movements of the fluid in the semi-circular canals, then electrodes might need to be fixed in the ears.

Then again, it is now well known that electric currents are generated in the body by the contraction of muscles, as well as by chemical action, whenever these may take place. These currents are exceedingly weak, too weak to be able to do any of the wonderful things that are alleged to be due to them by so-called "magnetic" healers. It requires the most delicate apparatus we have to detect them at all; nevertheless an electric current always has direction and a conducting circuit. The query is, which are the conductors in the body? The nerves have often been compared to conductors, and some have thought that the impulses in them, called "nervous transmission," were electric currents; on the other hand the measure of the rate of impulse has been found to be so low—less than 100 feet a second, that some have concluded that such nervous current could not possibly be electrical, inasmuch as the velocity of electricity is reckoned to be so great. This has never seemed to me to be conclusive. The old experiments for the velocity of electricity did not measure that at all. They at best indicated the rate of flow of a certain amount of electrical energy, which is a different problem. If a conductor be a poor one, it may take a good while to get enough electricity through it to produce any observable result, and that I think is the case with the electric conductivity of a nerve. Aside from the nerves, there are the blood vessels filled with good conducting materials, muscular tissues of various kinds not so good, and fatty tissue almost non-conducting, so that what will be the route of an electric current between two points in the body, may not be the same in different persons. I should expect that a given current would be much the densest in a lean or muscular person, and much scattered by adipose tissue, even a large surface electrode of a square foot which will carry a current of 22 milliampères without injury to the surface itself might, on account of slight conductivity of the underlying tissues, be made destructively dense in some portion of its course. I cannot give an example, but think it probable.

And last, but not least, what may be said of electricity as a curative agent? If one cannot give a technically correct description of it, yet this we do know, that an electric current is the bearer of energy in such a form as to be readily available for mechanical, chemical, or magnetic effects, and which of these will be the result depends altogether upon what kind of mechanism is provided for it. Inherently electricity has neither curative or destructive qualities. I do not think there is any evidence that it attacks life, or that in any sense it is life, as some have thought. One might as well say that heat is life, or chemism is life. Electricity has directly to do with molecules and atoms. It can shake molecules apart, and produce new molecular arrangements. If these new products chance to be useful or harmful to the organism, it will be benefited or injured. The particular advantage, which is a very great one, is, these products may be produced where they are wanted. This is now practically applied in electrolytic and catalytic adaptations. Its electrotonic action may be due more to the electrolytic products at nerve terminals than to their direct excitation. Considering a nerve as a conductor, its quality does not depend upon its conductivity, but its conductivity depends upon its quality. Is it not quite as probable that if nerve action is judged to be slothful, it is due to the fact there is nothing to conduct? That is, the metabolic changes at the nerve terminals are not rapid enough, as that the trouble is due to the nerve itself. This, of course, supposes the nerve to be intact.

I cannot forbear to allude to a matter of high theoretic interest directly related to electro-therapeutics.

Since it has been practically demonstrated that what we call light is a set of ether waves of electro-magnetic origin, it has been apparent to some—though others have not seen the significance of the work—that we are compelled to postulate that all atoms are magnets, seeing that all can, and do, give electro-magnetic waves. There was a good deal of reason for thinking so before. This new evidence seems to compel one to assume it. Hence on this assumption it follows that the living body is but a combination of an enormous number of atomic magnets. I use the term atomic advisedly, for molecules are but combinations of atoms, and their properties are only the resultant properties of the atoms that make them up. Every movement of every molecule and atom in the body is, then, a magnetic movement in magnetic fields, and must induce magnetic and electric changes all about it. It was long ago shown by Faraday that electrical and chemical changes were quantitatively related. Now it is seen that electro-magnetism underlies all chemical action. The significance of it here lies in the fact that in working with electricity to effect physiological changes one is really at work with the fundamental factor in physiological energy. Not in a roundabout, but in the most direct way.

Functions of all sorts are electro-magnetic in the last analysis, and

he who understands these, and the art of properly applying electro-magnetic energy to languishing or diseased organs, will be able to do all for humanity that skill can do. The more I study the relation of life to the things upon which it depends, the more I am persuaded that death may be for the benefit of the race, but it is not *necessary* for the individual.

PHOTOGRAPHIC ELECTRIC LIGHTS.

Mr. Rankin Kennedy delivered a short lecture on this subject last week at the offices of the *Photogram*, where an exhibition of photographic apparatus has been made, and the following extract will be of interest:—

He said: First of all we note that artificial light varies in quality, and in choosing a light for photographic work we must select one which gives the greatest amount of photographic light at the lowest cost, with the least labour and trouble. We know that all ordinary lights are made up of seven or more different coloured lights, some are bluish, some yellowish like gas, and incandescent electric light.

To show that the arc light has much more photographic light than the incandescent light, Mr. Kennedy showed one of the small "Gwynne-Pilsen" hand fed lamps, and by means of lenses focussed the arc on a screen; he then focussed an incandescent lamp run up in candle-power far beyond the normal state, as is used in the incandescent photo apparatus. (Both these images were photographed by Mr. Harold Baker, giving exactly the same exposure, and when developed the plate from the incandescent light was very faint, whereas the print taken from the arc lamp, was very distinct, dense, and decided.) The arc light is very rich in blue and violet rays, and these are the rays the photographer depends upon to do his work, while it is poverty stricken in reds and yellows, only comparatively speaking, for the spectrum of arc light shows quite an abundance of these colours also, but as these colours do not produce any effect on the photographic plate, they might as well be absent. The incandescent light has very little of the blue and the violet rays, and according to his measurements, and the results agreed with those of others, the arc light contains 30 per cent. more photographic or actinic rays than the incandescent light of the same illuminating power.

Now to compare the cost of the incandescent light and the arc light. The incandescent takes 80 ampères and 100 volts, which equals 8 units, the price of this is 4s per hour. At the high candle-power at which these incandescent lights are run, the makers would not guarantee them to last for one minute, but state they *might* burn for a day and a half, although they would guarantee nothing. Putting down the repairs and renewals at a very small figure, 1s. per hour, would bring the cost of the incandescent photographic light to 5s. per hour. Now, the arc lamp at 50 ampères and 100 volts, equals 5 units, or 2s. 6d. per hour, carbons at 1½d. per hour, total cost, 2s. 7½d. per hour, and by improvements that Messrs. Gwynne & Company have just worked out, this cost will be reduced to 1s. 5d. per hour, and the improvement can be fitted to any of their existing lamps at a small cost. The reason that, from a commercial point of view, the incandescent lights are so very costly, is, that by heating them to so high a candle power, the carbons are volatilised, and the carbon forms a deposit on the globe (which partly obscures the light next time they are switched on) and also reduces the diameter of the carbon thread, so that the next time the current is turned on, to produce the light, the filaments, being finer, and the globe obscured, a much smaller amount of light is obtained, and so on, thus showing that a photographer can never count on absolutely the same light, whereas with an arc light, the light is always the same, and a photographer can count on giving exactly the same exposure in every instance. From a commercial point of view, the incandescent photo-light must be a failure, owing to the enormous cost for current and renewals, and also from a photographer's point of view, as even when heated to the highest candle power, it does not contain the necessary photographic rays in sufficient quantity.

As regards automatic photographic lamps, the well-known "Gwynne-Pilsen" lamps are automatic. It is impossible for a photographer to adjust a hand fed lamp in the same perfect manner that a "Gwynne-Pilsen" automatic lamp can adjust itself. On a continuous current the arc lamp burns perfectly noiselessly, and if properly looked after, the cost of repairs is nil; the mechanism is simple, and it is not necessary to have an attendant to look after the feeding of the lamp while the photograph is being taken, as with a hand fed lamp. There is a slight hum with all alternating current lamps which cannot be avoided. The lamp will swivel in any direction, and will move about at any angle, and this is found by photographers to be a great advantage.

Messrs. Gwynne were the pioneers of the practical arc lamp for photographic purposes, and many of these lamps have been in use for three or four years, and are still working without trouble.

Mr. Harold Baker then gave a very interesting demonstration of the use of the lamp from a photographer's point of view, and said in most instances, he would much prefer to take a photograph with Gwynne's arc lamp to any daylight; he also uses his lamp for enlarging, for which purpose he finds it very useful.

Some lantern slides from negatives taken by the "Gwynne-Pilsen" photo lamp by Mr. Wm. Warneuke, of Glasgow, Mr. Frank Dickins of Sloane Street, and by himself, were then shown on the screen by Mr. Baker, some of the effects being very beautiful. The lantern was one of the well known make of Messrs. Watson & Sons, of High Holborn, to which had been fitted one of Messrs. Gwynne's small patent hand feeding electric lamps.

NEW PATENTS—1894.

19,065. "Improvements in or relating to the production of electricity." H. A. Tobias, W. H. Cadman, and R. J. Crowley. Dated October 8th.

19,121. "Improvement in electric arc lamps." J. E. Woolverton. Dated October 9th. (*Complete.*)

19,150. "Improvements in the method of and apparatus for the electro-deposition of metals." W. H. Beck. (Communicated by C. R. Fletcher, United States.) Dated October 9th.

19,157. "Improvements in or relating to electric battery plates." H. Le R. Bridgman. Dated October 9th.

19,176. "Improvements in or connected with telephone indicators or annunciators." L. M. Ericsson. Dated October 9th.

19,184. "Improvements in electric heaters." J. R. Davis. Dated October 9th.

19,185. "Improvements in electric switches or circuit breakers." F. Stevens and R. R. Kesteven. Dated October 9th. (*Complete.*)

19,186. "Improvements in electric thermostatic fire-alarms." L. G. Rowand. Dated October 9th. (*Complete.*)

19,191. "Improved means for securing the conducting wire to the carbon electrode in elements of galvanic batteries." F. A. von Alimonda and N. von Alimonda. Dated October 9th. (*Complete.*)

19,220. "Improvements in and relating to electric ship logs." W. D. Whyte and D. Muirhead. Dated October 10th.

19,247. "Improvements in electrical ceiling roses." G. F. Kenyon and E. Moorhouse. Dated October 10th.

19,285. "A novel construction or arrangement of electric or and gas chandeliers." M. V. Luis and E. C. Elgood. (Communicated by L. Priebe, Germany.) Dated October 10th.

19,286. "Improvements in electric motors, and appliances connected therewith partly applicable also to electric generators." L. B. Atkinson. Dated October 10th.

19,291. "Improved electric signal device." D. F. Adamson and C. D'O Hutchins. Dated October 11th.

19,343. "Motor vehicles for railways and tramways driven by gas or oil motor engines in combination with electromotors and accumulators." C. D. Abel. (Communicated by The Gasmotoren Fabrik Deutz, Germany.) Dated October 11th.

19,362. "Improvements in electrical safety devices." J. S. Raworth. Dated October 11th.

19,364. "Improvements in electromotors and like electro-magnetic apparatus." C. Connors and W. L. Davies. Dated October 11th.

19,387. "Improvements in magnetic shielding." G. F. F. Gerald. Dated October 12th.

19,421. "A method of hauling by electricity and apparatus for that purpose." F. B. Behr. Dated October 12th.

19,423. "Improvements in the construction of retorts or furnaces for the production of gases by the use of electricity." J. H. Dunn. Dated October 12th.

19,443. "Improvements in the electrical production of musical notes." P. T. Letchford. Dated October 12th.

19,444. "Improvement in electric arc lamps." G. G. Stout. Dated October 12th.

19,481. "An apparatus for heating water by electricity." J. W. Ewart. Dated October 13th.

19,508. "Improvements in cut-outs for use in electric circuits." C. P. C. Cummins and J. L. Goldin J. Dated October 13th.

19,517. "An improved apparatus for indicating the lamp-hours of electric lamps." R. Wende. Dated October 13th. (*Complete.*)

19,522. "Improvements in district telegraph calls." W. H. Garven. Dated October 13th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1893.

13,610. "Improvements in dynamo-electric machines." A. I. Gravier. Dated July 13th. In a machine constructed in accordance with this invention, the inductors are bipolar or multipolar. The pole-pieces are extended in the direction of winding in order to embrace as much as possible of the wire, so as to obtain the highest electromotive force for a given length of wire. At right angles to that direction, they are reduced so as to cover only three consecutive turns or coils of the armature, in order to have the three consecutive sections of the same potential. The armature is of soft iron sheets indented, all of which are insulated. They are in the form of a flat ring with its surface disposed in such a manner that it has the largest possible periphery for the section given, in order to utilise as much wire as convenient. The induced copper wire is wound in one or two layers, having, for each section induced, the necessary number of turns to provide the desired electromotive force. 5 claims.

14,647. "Improvements in apparatus for working electric tramways by means of underground cables." C. Anderson. Dated July 31st. The inventor encloses the cable in an iron or other box, without any slit or visible opening above, so that the box shall be practically dirt and watertight. At suitable intervals he perforates the top or cover of the box and through these perforations he makes contact with the cable below by means of short metal pegs, telescoping

through tubes of some insulating material and connected with suitable mechanism below, which rise through and above the top or cover of the box, and when they rise come in contact at the same time with the cable below and with a slider above, placed underneath the car to be propelled, and through which slider the electricity is conveyed to the motor by any suitable connections. 6 claims.

15,217. "Improvements in electric cables." G. C. Dymond. (Communicated by Silvanus P. Thompson.) Dated August 9th. A pair of insulated copper conductors, which constitue the outgoing and return wires of one circuit, is surrounded with a serving of iron in the form of a spirally enwrapped ribbon or tape, so wrapped around the gutta-percha or insulating material beneath as to overlap at the edges and leave no crevice for the attack of the teredo. 3 claims.

15,231. "Improvements in electric arc lamps." A. J. Boult. (Communicated by A. Bureau, of Brussels.) Dated August 9th. Consists of a plate supporting two columns, which are connected together by a yoke, and serve in guiding the two carbon holders, which latter are connected together by any suitable means, such as a cord passing over a grooved pulley.

15,486. "Improvements in appliances operated by a door for turning up or down electric or other lights." E. Mann, and J. Hopwood. Dated August 15th. Consists in applying the switch proper to the door frame, and a spring pawl to the door. 2 claims.

15,577. "Improvements in electric furnaces." F. Chaplet. Dated August 16th. Relates to a furnace with movable electrodes, and comprises *inter alia* improvements in the form of electric furnace originally employed by M. Moissan for the preparation of artificial diamonds. 1 claim.

15,686. "An improved material or compound adapted for use as a varnish, as a substitute for India-rubber, gutta-percha, and like substances, and for other purposes, and the process for its production." C. U. King and R. V. Jellicoe. Dated August 18th. Consists in dissolving, in a solvent, prepared as hereinafter described, cotton-wool, paper, esparto grass, or other suitable cellulose material, rendered soluble by treatment with nitric and sulphuric acids and water, in the well-known manner, as applied to the manufacture of collodion cotton, or soluble gun-cotton. The said solvent is prepared by distilling methylated spirit, which has been treated with quicklime, potassium carbonate, or other suitable agent to absorb or remove the water contained in the spirit, and adding to the distillate a percentage of methylated ether varying from 5 per cent. upwards, or, in place of the addition of the said methylated ether, by distilling with the methylated syirit, a hydro-carbon, preferably benzole, or by a combination of the said methylated spirit, hydro-carbon and methylated ether. To the cellulose fibre, when dissolved in the above solvent, is added castor oil, or gum copal and castor oil, according to the flexibility required in the finished material. 7 claims.

17,603. "Arc lamp." A. S. Atwater. Dated September 19th. The objects are to provide a type of lamp which will be self-sustaining, and will require adjustment only at very long intervals. 4 claims.

18,019. "Improvements in electrical switches." J. H. Tucker. Dated September 26th. The motion of the handle forces a contact arm into such a position that the circuit is closed, and at the same time compresses a spring, which is placed in such a position, that it tends to force the contact arm to its "off" position. 4 claims.

18,152. "Improvements in cylinders and pistons for gas and other heat engines" J. Vaughan-Sherrin and C. N. Garner. Dated September 27th. Consists in constructing the cylinder, so to say, of two parts, viz., the one in which the explosion takes place and which is made of thick hard stoneware or earthenware, or other suitable non-conductor of heat which may be held in an outer steel or iron case or cylinder, and the other made of cast iron or other suitable metal, the two parts being fixed end to end. The piston is likewise made in two parts the one made of hard stoneware or earthenware or other suitable non-conductor of heat, and the other of ordinary metallic construction, the latter working gas-tight in the metallic part of the cyiinder, while the stoneware end works with an easy or slack fit in the stoneware part or end of the cylinder. 1 claim.

18,173. "Improvements in apparatus for the electrolysis of chlorides and other salts." J. Habgreaves and T. Bird. Dated September 27th. Relates to an improved construction of apparatus for use in decomposing chlorides, iodides, bromides, nitrates, and other salts, and adapted to operate on the principle of that described and claimed in specification No. 18,871, A.D. 1892, the primary object of the present invention being to render such apparatus more compact. 4 claims.

18,530. "Improvements in the arrangement and connection of conductors for electric railways." Siemens Bros. & Co., Ltd., and G. H. Thornton. Dated October 3rd. Claim: A three-wire arrangement of the conductors for a double line electric railway, the positive and neutral wires serving the locomotives on the one line of rails, the neutral and negative wires serving those on the other line, and the connections for cross over roads being made with gaps filled with dummy pieces on which the collecting trolleys can travel, substantially as and for the purpose set forth.

18,602. "Improvements in telephone switchboards." C. D. Abel. (Communicated by Société Générale des Teléphones, of Paris.) Dated October 4th. Relates to a construction of telephone switchboard having the rows of spring jacks, and the bands by which they are connected to their respective wires, so arranged that any row can be drawn out forwards from the fixed-framing for inspection or repair, and similarly any band can be drawn out backwards. 2 claims.

18,661. "Improvements in electric telegraphs for steering, engine room and other signalling purposes." F. G. P. Preston. Dated October 5th. In the helm, or other indicators and receivers constructed according to this invention, an armature is employed consisting of horse-shoe magnet bobbins capable of angular motion round a centre. This armature is so weighted as to cause the pointer to assume a neutral or other desired position on the cessation of current. Concentrically around the same is arranged a number of fixed electro-magnets equidistant, and converging to the centre, and in opposite pairs electrically connected by wires to a corresponding number of contacts on the indicating instruments. In order to enable each pair of fixed magnets to be used for signals placed diametrically opposite on the dial two sets of wire windings are employed, on opposite pairs of bobbins, and each connected with contacts corresponding to the signals desired. The current from the dynamo is directed by a suitable switch arrangement into the circuit corresponding to the signal desired. 4 claims.

18,674. "Improvements in electrical receiving instruments and relays." The Phonopore Company, Ltd., and C. E. Spagnoletti. Dated October 5th. Relates to electrical receivers and relays so constructed that a succession of alternating or intermittent currents, direct or induced, of various frequencies, transmitted along a conducting line, shall cause an armature to give audible or visible signals, or to effect variations of resistance in a local circuit arranged for the production of audible or visible signals. 1 claim.

18,690. "Improvements in conduits for electric conductors." C. G. Picking. Dated October 5th. The conduits are manufactured in lengths, and either with one passage way or with several passage ways therethrough. Each length is formed with a socket and spigot end, and in a manner such that the lengths engage with each other so as to prevent twist and secure concentricity of all the lengths. 3 claims.

18,805. "Improvements in electric measuring instruments." B. Davies. Dated October 7th. Has for its object an electric measuring instrument so designed that it may be used as an ammeter, a volt-meter, or a watt-meter. 3 claims.

18,951. "Improvements in electricity meters." J. Edmondson. Dated October 10th. Consists of a clock or time piece fitted with a cam or cams, or other device, such as an eccentric pin or pins, which actuates or actuate a movable gear wheel, clutch or other device, whereby the recording is transferred from one dial train to the other. 4 claims.

19,018. "Improvements in a system of electrical transmission." J. A. Davis and R. A. Fowden. Dated October 10th. Relates more particularly to a step by step electric-motor for controlling synchronously telegraphic printers, clocks, and other instruments. 33 claims.

19,183. "Improvements relating to the transmission of signals through submarine and like cables, and apparatus for effecting the same." A. Muirhead. Dated October 12th. Consists in substituting a series of friction wheels for the toothed wheels of the usual clock-work train and actuating the same by means of an electromotor or other convenient source of power in lieu of the usual clockwork mechanism thereby rendering the whole apparatus steadier and more silent in its action. 16 claims.

19,465. "Improvements in systems of electric distribution." C. A. Allison. (Communicated from abroad by C. O. Mailloux, of New York, and W. S. Barstow, of Brooklyn.) Dated October 17th. Consists broadly in the use of distinct graded potentials, however, produced, for the several feeder circuits or sets of circuits; each potential being adapted to a different condition of feeder load or length, with suitable feeders for shifting the feeders from one potential to another as occasion may require, in combination with a potential regulator which may be either a source of regulable electromotive force or a rheostat adapted to be connected and disconnected from the feeder terminals and employed to artificially and temporarily vary the potential of a feeder terminal as an accessory step to the switching operation. 16 claims.

19,791. "Improvements in or connected with electrolytic cells." F. Hurter, H. Auer, and E. K. Muspratt. Dated October 20th. The inventors make the cell or containing vessel of metal, preferably iron or the like and place the said cell or containing vessel on porcelain slabs or the like so as to effect insulation. They use the cell or containing vessel as the cathode by connecting it to the negative pole of a dynamo or battery or other suitable electric generator. In the cell or containing vessel they place an inverted trough or bell-jar made of earthenware or other suitable material and provided with openings for the escape of the chlorine gas and they suspend from the top of the said trough or bell-jar and within it a carbon anode suitably connected to the positive pole of the electric generator. 2 claims.

21,629. "Improvements in cable and submarine telegraphy." P. B. Delany. Dated November 13th. Consists in the adoption of regularly alternating impulses, the utilisation of each impulse as a signal, and the maintenance of the movable part of the receiver in a normally central or zero position, susceptible to actuation in either direction according to the polarity of the current, and an arrangement of local contacts for the movable part of the receiver so that while it is in its normal position with no current on the line, the sounder or final receiver is open, and when the movable part of the receiver is actuated to either side of this central position by a current of either polarity, the sounder is operated. 22 claims.

22,184. "Regulating apparatus for electromotors." C. D. Abel. (Communicated from abroad by Berliner Maschinenbau Aktien Gesellschaft vorm. L. Schwartzkopff, of Berlin.) Dated November 20th. The present invention relates to a method of connecting electromotors by simultaneously so altering the connections of the armature winding and the strength of the field magnet winding that the position of the neutral axis remains unaltered, and that consequently no shifting of the brushes after each regulation of the speed is required. 3 claims.